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IN THIS ISSUE

DEPARTMENTS

DEPARTMENT OF DEFENSE

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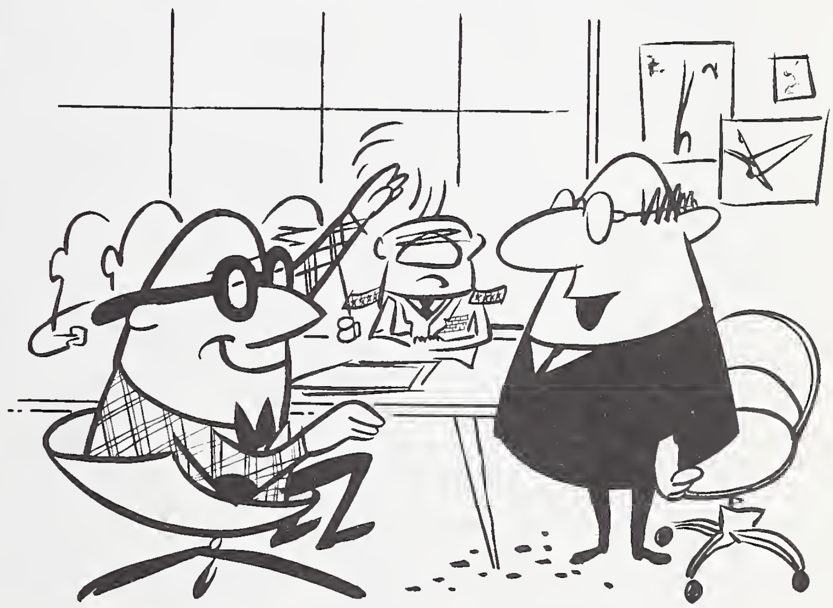
Problem Mongers, Solution Mongers and Weapon System Effectiveness



"MR. CONRAD, I DON'T WANT THE ANSWER YET. I'M ONLY HALF-WAY THROUGH THE PROBLEM . . ."

The illustration above sums up the problem/solution dialogue which is discussed in depth by Mr. Paul Sturm, of the Office of the Director, Defense Research and Engineering, in the article beginning on Page 1.

Defense Department Encourages Skill Development and Training of Nation's Manpower Resources

The following is a letter from Deputy Secretary of Defense Cyrus R. Vance addressed to the defense industry community concerning the need for skill development and training of the nation's manpower resources:

Dear Defense Contractor:

President Johnson in his 1966 Economic Report to the Congress reported, on the sixth year of economic growth, the greatest upsurge of economic well-being in the history of any nation. He referred to several questions being asked about our ability to continue this expansion, including these:

> **Can our employers find the labor they will require to man their production lines?**
>
> **Can we avoid bottlenecks in major industries or key skills that would hamper our expansion?**

While the President was confident these challenges would be met he stressed that the concerted efforts of industry, labor and the Government were required to achieve the approaching full use of the nation's resources.

In this context, and particularly as we approach full employment, the Secretary of Labor has called attention to the importance of training as a constructive method of meeting manpower requirements. I take this opportunity to join with the Secretary of Labor in emphasizing the concern of the Federal Government that we as a nation improve our skills development programs to meet reasonably foreseeable needs. Anticipating and planning to meet such needs are, of course, obligations first of all of the employers who will need the skilled personnel. This obligation rests with particular force upon those employers who as defense suppliers should be especially forward looking in this regard. I accordingly urge that defense contractors evaluate their requirements across the entire skill spectrum and make affirmative efforts to contribute at least as much through training to the development of the qualified manpower pool in each occupational band as they utilize that pool.

The Secretary of Labor has also advised that employers, desiring advice and assistance in assessing skill development needs and in planning training programs, may obtain such advice and assistance from the Bureau of Apprenticeship and Training of the U. S. Department of Labor. Assistance is available at all occupational levels up through and beyond the apprenticeable trades. Various federal and state resources are available under Department of Labor programs for paying part of the cost. Inquiries can be made at field offices of the bureau which are located in the larger urban centers, and by communicating with its Washington headquarters (Bureau of Apprenticeship and Training, U.S. Department of Labor, Washington, D. C. 20210).

Sincerely,

Cyrus Vance

DEFENSE INDUSTRY

BULLETIN

Published by the Department of Defense

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The purpose of the *Bulletin* is to serve as a means of communication between the Department of Defense (DOD) and its authorized agencies and defense contractors and other business interests. It will serve as a guide to industry concerning official policies, programs and projects, and will seek to stimulate thought by members of the defense-industry team in solving the problems that may arise in fulfilling the requirements of the DOD.

Material in the *Bulletin* is selected to supply pertinent unclassified data of interest to the business community. Suggestions from industry representatives for topics to be covered in future issues should be forwarded to the Business & Labor Division.

The *Bulletin* is distributed without charge each month to representatives of industry and to agencies of the Department of Defense, Army, Navy and Air Force. Requests for copies should be addressed to the Business & Labor Division, OASD(PA), Room 2E813, The Pentagon, Washington, D.C. 20301, telephone, OXford 5-2709.

Problem Mongers, Solution Mongers and Weapon System Effectiveness

by

Paul J. Sturm

Asst. Dir. (Plans and Policy)

Office of Dir., Defense Research and Engineering

Can cost effectiveness of military research and development be measured? This question has been occupying substantial attention within the Defense Department for some time. To date, findings of internal DOD studies have provided an answer to the question. The answer, simply and ambiguously, is, "It depends."

It depends principally upon three characteristics of the developmental materiel being considered. These characteristics are:

- The conceptual maturity of the program.
- The developmental maturity of the materiel.
- The degree of operational uncertainty involved in the employment concept.

Therefore, before a more unambiguous answer can be developed to the question, "Can the effectiveness of R&D be measured," it's necessary that we examine the fine structure of the objective and maturity of the materiel in question. This article will be concerned with certain aspects of this fine structure and, hopefully, will show by inference that certain end-use-oriented R&D efforts can be measured for effectiveness during the developmental phase, and that the remainder may well suffer from the attempt.

Before we examine the three characteristics just mentioned, it will be useful if we review, at least superficially, the process that determines how new weaponry and support materiel comes into being in the first place. Buried in this exotic mechanism live several unruly boundary conditions that circumscribe and limit the areas of application of the varying forms of systems analysis and other modern study disciplines. The qualitative requirements definition process, which is the name for the way that new materiel is conceived, gestated and reared, is the basic process that incorporates, in one way or another, almost all of the elements involved in the management of organized technical effort, including the setting of objectives, planning, persuasion, analysis, negotiation, decision, and execution or acquisition.

The Development Requirements Process.

In order to normalize our mutual understanding of the development requirements process, stated below is a definition that has been developed for internal use in the Defense Department:

> **"The way the Department of Defense evolves the qualitative statements of its needs, and determines the performance characteristics of the materiel necessary to meet those needs."**

The process starts with one of two stimuli—with a technological solution or with the emergence of a problem. Later on this will be treated in greater detail. The process peaks in influence on the R&D cycle late in exploratory development and throughout advanced development. Finally, the process continues to exert influence long after initial operational capability, in the form of mod-kits, retrofits and improvements.

Who is involved in this process? A simple answer is: everyone, who, in one way or another, is involved in materiel support of the Military Forces. In this period of technological warfare, this is practically everybody. The President is involved in it. The Cabinet, the Congress, the Bureau of the Budget, the Military Departments, the Defense Secretary, the Joint Chiefs of Staff, the Commanders in Chief and the technological community—the universities, the defense industry and the not-for-profits. Everybody is involved and everyone has an opinion. However, each participant views the process from his own unique perspective.

For this reason, the pattern of this process cannot be isolated by analysis of case histories. That approach was tried. It seemed reasonable that if enough case histories of specific developments could be analyzed, a statistical pattern might emerge from which conclusions could be drawn that were supported by these so-called factual statistics. It soon became apparent, however, from repeated experience, that the many versions of the same case were used by the proponents to "prove" conflicting and usually opposing views of the history of the conception of a project. Redeye, as a classical case, was offered by various individuals as an example of a weapon that was:

- Developed as a result of a stated need.
- Developed in the absence of a stated or recognized need.
- Developed as a consequence of technical innovation.

Experiences like this demonstrated conclusively that the use of case histories to provide an unambiguous representation of the process was completely impractical. This investigation revealed also that a great number of widely differing envisionments existed concerning how the process actually worked in real life.

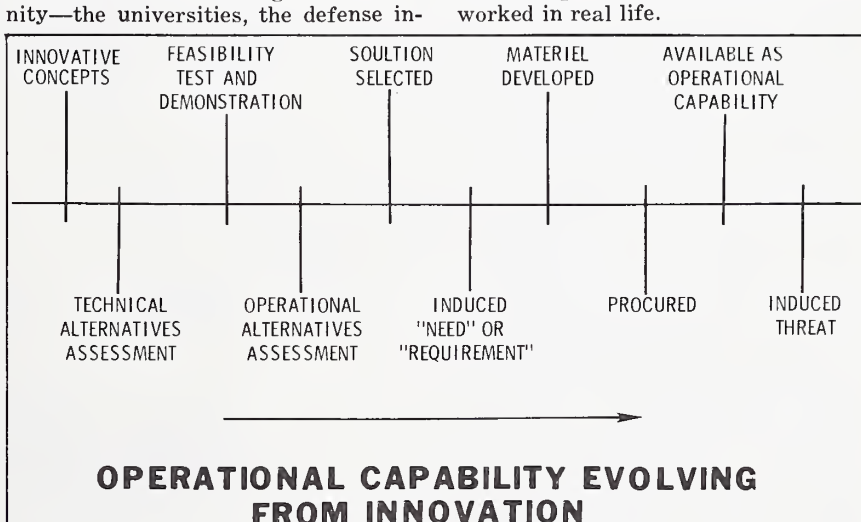

Figure 1.

In the space available here it is not possible to discuss the many variants that have been constructed on how the process works. However, let's take a look at the two patterns or themes that seem to be repeated in most of these constructions and which appear to be fundamental to the process. At the risk of over-simplification, the idealized planner's view can be depicted as shown in Figure 1. With time elapsing from left to right, this graph spells out how operational capability evolves from the threat or the problem.

Over-simplifying again, the pragmatist's view of the same process can be represented as shown in Figure 2. Here, operational capability, and the threat induced by the availability of the hardware, is derived from the innovation, or the technical opportunity or solution.

If we place these two views adjacent to each other (Figure 3), it becomes apparent that the principal divergence centers around the sequence of the evolution and not over the bench marks, since these on each graph have much in common. Furthermore, the divergence seems to be mostly confined to the period prior to the time that the specific hardware is selected.

Both views have merit. Examples can be found of materiel that has been brought into existence by the route of the planner. Similarly, examples exist of materiel that came into being via the pragmatist's route. However, the issue is somewhat academic since a review of the total spectrum of materiel being acquired today by the Military Departments and Defense agencies will disclose that a very small percentage came into being by way of these purely theoretical routes. Whether the origin of the stimulus was the problem (threat) or the solution (innovation) is immaterial. The bench marks previous to the selection of the final approach are never cleanly defined, expressed, or sequential. Instead these bench marks merely represent activity that takes place at one time or another during the refinement process. In other words, this period, previous to solution selection, is an environment of iteration. This period is unordered and unpredictable and doesn't lend itself very manageably to any sequencing or methodology. It's a stage of continuous, almost random, communication, interchange and negotiation between operational needs and technical possibilities.

This is the early evolutionary phase, then, of the creative process from which weapons and equipments emerge, which shortly thereafter matures into the interplay of the three basic criteria for decision—operational suitability, technical feasibility and cost acceptability. At this early stage of the process, the interplay is principally concerned with operational and technical considerations, with cost playing a decidedly subdominant role. This interchange has been dubbed the requirements definition dialogue, which will be identified later as an identifiable step in the overall process.

In reality then, the real process is a mixture of both theoretical views. While each eventual piece of hardware matures in its own unique way, it matures only as a result of negotiations between those representing operations and those representing technology. In all fairness to the two pure schools of thought, the planner's view is generally identified most closely to projects or programs of an improvement nature, i.e., items that are faster, higher, longer range, etc.; whereas, the pragmatist's idea relates best to programs that are characterized by breakthrough, new capability, quantum jump in the state of the art, etc.

Problem Mongers and Solution Mongers.

Let's for a moment look a little closer at this dialogue between operational needs and technological possibilities. It was pointed out earlier that the necessity for free and unfettered interchange between these two elements is vital to the fault-free definition of needed capability. If the proforma, or paper, process should begin to pace events rather than record them, free and unhampered negotiation between the problem and solution people is inhibited by these paper procedures, theoretical sequence patterns and the need to conform to the organization.

We've adopted the term "problem monger" for those that are looked to for a dispassionate and unprejudiced statement of the problem that needs to be solved; and the term "solution monger" for those who can competently assess what is technically possible in the time frame under consideration. In general, the military professional, with his experience in the combat or operational environment, would normally be looked to for problem statements and, therefore, represents the problem monger. Representatives of the technological community, which includes the technical component of the Military Departments, the universities and the defense industry laboratories, personify the solution mongers.

Unfortunately, however, the problem mongers and solution mongers, nowadays, don't divide up neatly in this fashion. It appears at times that we are living in an age of solution mongers. Many of you are aware of how often new operational needs are described in terms of a preconceived hardware solution rather than by the basic operational problem to be solved. In all fairness, of course, a clear operationally oriented statement of the problem, unprejudiced by a preconceived specific solution, is a difficult task. People have fallen into the habit of specifying future needs in terms of the performance characteristics of a particular pet hardware project rather than in terms of the basic operational characteristics necessary to the successful completion of the mission in the environment of the end user in the field.

At times it seems that the military professional and technological professional are playing musical chairs, in that the Military Departments are

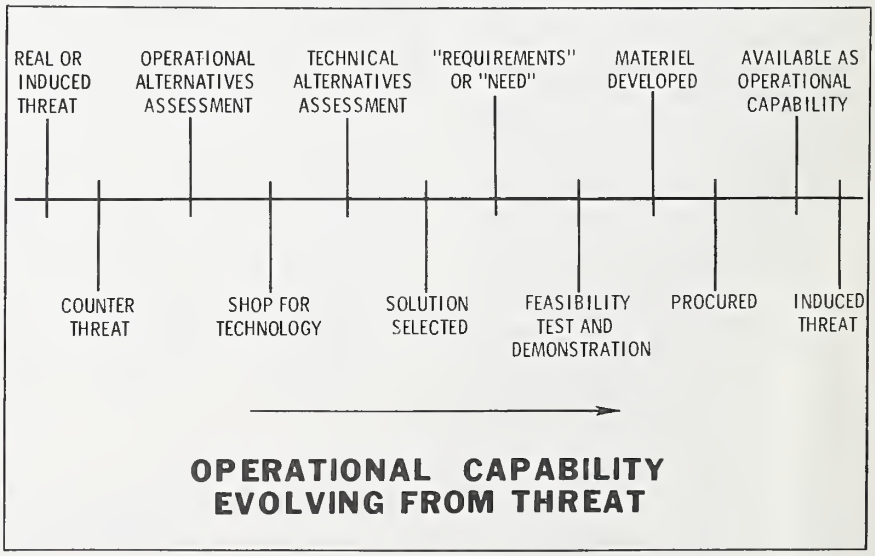

Figure 2.

turning more and more to civilian-dominated contract study organizations for analyses that concern serious strategic and tactical issues. At the same time the Departments busy themselves with the development of technical solutions responsive to the operational problems posed by these civilian-dominated studies. In other words, contract civilian analysts are becoming the problem mongers. Contrasted to this, the military professional, who by virtue of his career should be best qualified for problem stating, instead is working along with the technical professional as a solution monger. It's worth noting that this poses the danger that the military professional has been disenfranchising himself from his rightful participating role as a shaper of the materiel with which he will be equipped for combat operations in the future.

The interjection of staff elements between the problem monger and the solution monger dilutes and distorts the quality of the interchange and reduces the freedom to negotiate. Considerations other than the operational problem and the technical solution are introduced prematurely in this early phase and muddy the dialogue. Important consideration—that only the staff echelons can provide—must obviously shape the ultimate statement of needed capability. But when these considerations receive such visibility in the early stages that they eclipse the clear and consistent statement of the initial operational problem to be solved, the system begins to fault.

In similar fashion, when echelons of organization that are charged with representing the technical solution, and at the same time are expected to represent other considerations—who builds it, how much does it cost, etc.—they similarly introduce premature complication which impedes free interchange. Inhibited communication means faulty capability statements and proposals. Faulty because either they reflect unrealistic technical specifications or the desire for general purpose capability; or faulty, on the other hand, because they are poorly adapted to the end-use environment, because of specifications that are dominated by technology instead of the operational problem.

Since virtually all interposing echelons have a non-linear characteristic, it can readily be seen that, no matter how good the input from the problem and the solution monger, there will be plenty of distortion introduced into the negotiation. Then the output, in the form of a capability statement, is bound to be laced with distortion.

Cost Criterion.

Let's turn now to the cost criterion during the early phase just described. Since RDT&E decisions are based upon three basic criteria—operational, technical and cost—it might appear that the cost issue has been shortchanged up to this point in the pattern under consideration. While visibility on cost factors has been low thus far in the process, this shouldn't be construed as a reflection on its importance. Keep in mind that every potential or on-going development project, while in the school of requirements definition, is constantly faced with the necessity of passing a final examination before graduating into inventory, namely the cost-effectiveness test. A major goal of all materiel acquisition is maximum effectiveness at minimum total lifetime cost. Dollar economics can't be limited only to the intrasystem study phase occurring after solution choice. Instead, cost participates in varying degrees with other criteria in disciplining the choice of the specific approach from among the alternatives. Unless cost considerations are factored into the analyses and studies that identify the chosen solution, the proposed program stands a good chance of foundering along the way.

On the other hand, each technical and operational alternative deserves the opportunity for serious consideration and, if promising, feasibility investigation without the inhibition of premature speculation on future costs. Cost estimates taken too seriously too early can well stifle or strangle new concepts or innovations that have latent merit. A proposed solution early in the process, that may at first glance appear to be entirely unacceptable cost-wise, may well evolve into a completely cost acceptable program. Evolutionary refinement and change always occur during the period of feasibility investigation and experimentation. Future cost speculations can destroy or delay a vital future capability before it's even born if they are permitted to inhibit or kill consideration of conceptual options.

When is the appropriate time for the introduction of cost considerations? This is a critical question and difficult to answer. However, to bracket the issue and identify the limits, a few general observations can be made. For virtually all solutions specifically responsive to an operational problem, life-time cost is quite sensitive to choice decisions during the mid-period of the evolutionary cycle. If these choice decisions are made independent of cost acceptability testing—and I distinguish here between cost acceptability testing and cost effectiveness testing—the resulting materiel, later on in the development cycle, may fail formal cost effectiveness tests when, for example, it's a candidate for possible inclusion in the inventory. On the other hand, innovational solutions, feasibility demonstrations and new experimental systems concepts present a somewhat different cost acceptability challenge. The time for the introduction of cost estimates during the early period of this type of project is, of necessity, determined empirically by technically dominated judgment. Premature injection of cost issues here can seriously jeopardize the freedom from unwarranted constraint necessary to the successful maturing of these concepts or innovations.

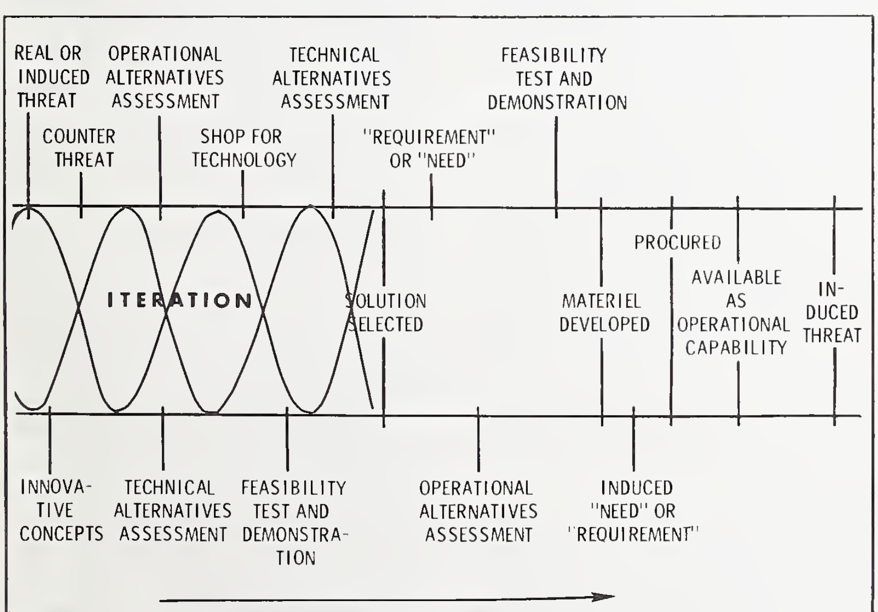

Figure 3.

Nevertheless, undue postponement of economic acceptability testing permits unwarranted freedom from a basic practical discipline. This can lead to wasteful or fruitless development of proposals which may end up on the scrap heap because of cost. The proper time, then, to introduce dollar discipline into this kind of program is a fine point of judgment and depends upon technical acuity, vision and discrimination.

Before we leave this issue, it might be worthwhile to re-emphasize that cost acceptability is increasing in importance each year due, in part, to the terrifying escalation of the economics associated with the increasing sophistication of military weapons and materiel. After all, it's not unusual these days to be considering weapon systems whose total cost represent an impressive percentage of the annual Federal revenue. Small wonder, with figures like these, that everybody, including the Congress, is concerned with this requirements process.

The Requirement Process and the R&D Cycle.

You will note up to this point that the influence of the requirement process appears to be peaking in the advanced development phase of the R&D cycle. Research and exploratory development are not end-use oriented. They're programmed on a level of effort basis and aren't directly concerned with the issue of end use or operational capability. Similarly, during engineering and operational systems development—when decisions are mostly concerned with whether or not to include in inventory—the issue of needed qualitative capability (in theory at least) is fairly well frozen. It's worthwhile, therefore, to take a closer look at the character of the advanced development category of effort.

One of the least understood aspects of the RDT&E cycle is the evaluation of advanced development projects within the category itself and the movement of projects from advanced development to engineering development. With the refinement of the concept of contract definition, advanced development umbrellas two objectives, namely, "innovation investigation" and "prerequisites to contract definition."

The criteria used to evaluate prerequisites to contract definition developments differ markedly from those employed in assessing innovation development. Figures 4 and 5 give a breakdown of the two environments. You will note that the two environments are almost antithetical with respect to criteria for evaluation.

The strikingly different objectives of these two kinds of advanced development reveals that application of pre-contract definition criteria to innovation proposals will result in stifling the effort, through demand for more and definitive studies and analyses, to justify its funding. A clear understanding of the objective of the project in advanced development, therefore, is necessary in assessing the value of the proposal and the desirability of instituting the effort. In other words, again we see the need for a clear enunciation of the basic problem to which the proposed solution is intended to be responsive. If this statement of the problem is treated superficially or not clearly identified in terms of the objectives contrasted in the breakdown, the proposal or project is in for potential trouble because of evaluation criteria not being matched to the effort.

From the foregoing it may sound as if it's impossible to manage or measure research and development during the needs-definition period in an orderly and understandable way. Admittedly, this environment doesn't lend itself readily to routine or regularized management treatment because of the unordered character of this period and the necessity for opportunism. The manager is always beset with this formidable challenge, i.e., to manage with a light hand at the right time in the cycle so that the very act of management doesn't destroy the immature concepts that need nurturing in this early period. While nursing these concepts during feasibility demonstration, he must test them for operational suitability and, when sufficiently mature, shape them to fit an end-use objective so that the project solves the operational problem in the most efficient way—in other words, so that the operational capability that they will represent will be effective in the intended environment. And finally, the concepts must be harnessed at the right time to the real world of the budget—in other words, can we afford it and is the design optimized and cost conscious?

While the pre-decision activity is disorderly, nevertheless, the challenge just described suggests the three fundamental forms of study that are employed in the generation of materiel. The studies and analyses that work to shape the proposal so it solves the operational problem are identified under the heading of the requirements-definition dialogue. A second form of study, which represents the interchange between operations and cost, is of course the cost-effectiveness analysis. And finally, the studies concerned with optimizing the specific design to maximize its value per dollar expended can be collected under a general heading of technical cost trade-off studies.

These three forms of study, the requirements-definition dialogue, the cost-effectiveness analysis and the technical cost tradeoff, represent analytical interchange between the three bases for decision—operational, technical and cost—and through interaction generate the basic information which the decision maker tests against the criteria of operational suitability, technical feasibility and cost acceptability, in determining whether to initiate or reject a proposed project.

This pattern of studies strives to reduce the disorder of the early R&D environment. It's admittedly a theoretical pattern and obviously will not apply directly to any one specific, since each discrete proposal filters upward to the decision maker according to its own path, that depending on the unique uncertainties of each case.

PRE-CONTRACT DEFINITION ENVIRONMENT

- Project ready for hard engineering and experimental effort already accomplished.
- Technical approach selected is best approach from competing alternatives through convincing trade-off analyses.
- Mission and performances envelopes of project defined and optimized.
- Credible cost and schedule presentation exist.
- Favorable cost-effectiveness presentations available.
- Specific military requirement firm.
- Evaluations made in end-use/specific solution-oriented environment.

Figure 4.

INNOVATION ENVIRONMENT

- Programs are principally study and experimental effort to demonstrate feasibility.
- Concepts are principal issue, with alternative solutions incidental to effort.
- Project concerned with feasibility and not susceptible to optimization.
- Definitive cost and schedule considerations premature.
- Cost-effectiveness analyses may be academic due to unrefined concept of employment.
- Firm military requirements contingent upon feasibility demonstration.
- Definitive end use difficult to define and subject to results of feasibility demonstration.

Figure 5.

(*Continued on page* 16)

ABOUT PEOPLE

DEPARTMENT OF DEFENSE

B. F. Coggan has been appointed a special consultant to the Asst. Secretary of Defense (Manpower) with responsibility for reviewing the management of military medical facilities, commissaries, post exchanges and other related support services concerned with the health, welfare and recreation of military personnel. Mr. Coggan is president of the San Diego International Development Corp., and has held executive positions in various industries.

Lt. Gen. Fred M. Dean USAF, Asst. Dir., Weapons Evaluation and Control, U.S. Arms Control and Disarmament Agency, has been named Dep. Commander in Chief, U.S. Strike Command. He will assume his new position Aug. 1.

Maj. Gen. Marvin L. McNickle, USAF, has been nominated for promotion to lieutenant general and designated Dep. Dir., Defense Research and Engineering (Administration and Management).

Brig. Gen. Robert C. Richardson, III, USAF, formerly Dep. Chief of Staff, Science and Technology, Air Force Systems Command, has been assigned duty as Dep. Commander, Field Command (Weapons and Training), Defense Atomic Support Agency, Sandia Base, N.M.

DEPARTMENT OF THE ARMY

Seven top ranking Army general officers are affected by a series of major reassignments as follows: **Gen. Dwight E. Beach** has been named Commander-in-Chief, U. S. Army, Pacific, replacing **Gen. John K. Waters,** who is retiring. Replacing Gen. Beach as Commanding General, Eighth U. S. Army; Commander, U. S. Forces, Korea; and Commander-in-Chief, United Nations Command, is **Lt. Gen. Charles H. Bonesteel III,** who has been Dir. of Special Studies in the Office of the Army Chief of Staff. Gen. Bonesteel has been nominated for promotion to full general. **Lt. Gen. John L. Throckmorton,** previously Chief of the Army's Office of Reserve Components, replaces Gen. Bonesteel. Gen. Throckmorton's replacement is **Lt. Gen. Charles W. G. Rich,** who has been Dep. Commanding General, Eighth U. S. Army. **Lt. Gen. Vernon P. Mock,** previously Dep. Chief of Staff for Military Operations, replaces Gen. Rich. **Maj. Gen. Harry J. Lemley, Jr.,** Commandant of the U. S Army Command and General Staff College and Commanding General, U. S. Army Combat Developments Command's Combined Arms Group, replaces Gen. Mock. Gen. Lemley has been nominated for promotion to lieutenant general.

Lt. Gen. Robert Hackett, previously Comptroller of the Army, is the new Commanding General of the U. S. Army Air Defense Command, replacing **Lt. Gen. Charles B. Duff** who has retired. **Maj. Gen. Ferdinand J. Chesarek,** who has been nominated for promotion to lieutenant general, replaces Gen. Hackett as Army Comptroller.

New assignments in the headquarters of the U. S. Army Strategic Communications Command are: **Col. Eugene L. Weeks,** Dep. Chief of Staff for Logistics; **Col. William G. Skinner,** Dep. Chief of Staff, Comptroller; and **Col. Lawrence R. Klar,** Dir., Communications Engineering Dept.

Col. E. J. McGinnis has been assigned as Dir., Procurement and Production, of the Army Missile Command, Huntsville, Ala.

The new Commanding Officer of the Rock Island (Ill.) Arsenal is **Col. Harry A. Snyder.**

DEPARTMENT OF THE NAVY

RAdm. Francis J. Blouin has been named to succeed **VAdm. Bernard F. Roeder** as Commander, Amphibious Force Pacific. Adm. Roeder will take command of the First Fleet in San Diego. **VAdm. Lawson P. Ramage,** who has been Commander of the First Fleet, has been assigned as Dep. Commander-in-Chief, U. S. Pacific Fleet.

RAdm. Elmo R. Zumwalt, Jr., has been assigned as Dir. of the Systems Analysis Group, Office of the Chief of Naval Operations.

RAdm. Frank C. Jones is the new Dep. Chief of Naval Material (Logistic Support) replacing **Capt. John B. Ritch** who has retired.

RAdm. William C. Richardson, SC, has been assigned as Supply Officer, Philadelphia Naval Shipyard.

Maj. Gen. James M. Masters, Sr., USMC, has been nominated for promotion to lieutenant general and assigned as Commandant of Marine Corps Schools, Quantico, Va. He succeeds **Lt. Gen. Frederick L. Wieseman** who has retired.

DEPARTMENT OF THE AIR FORCE

Gen. Bruce K. Holloway has been designated Vice Chief of Staff, USAF, effective Aug. 1, replacing **Gen. W. H. Blanchard,** deceased. **Lt. Gen. Maurice A. Preston,** Commander, U.S. Forces, Japan, and the 5th Air Force, will replace Gen. Holloway as Commander, U.S. Air Forces in Europe.

Lt. Gen. Joseph R. Holzapple, presently Dir., Weapon Systems Evaluation Group, has been named Dep. Chief of Staff, Research and Development, USAF, effective Sept. 1.

Lt. Gen. Richard M. Montgomery, Vice Commander in Chief, U. S. Air Forces in Europe, will retire Aug. 31. His replacement is **Maj. Gen. Arthur C. Agan, Jr.,** who has been nominated for promotion to lieutenant general.

Lt. Gen. Henry Viccellio will become Commander, Continental Air Command, on Aug. 1; **Lt. General Sam Maddux, Jr.,** assumed command of the Air Training Command on July 1; **Lt. Gen. Joseph H. Moore** became Vice Commander in Chief, Pacific Air Forces, on July 1; **Maj. Gen. Seth J. McKee,** nominated for promotion to lieutenant general, will become Commander, U. S. Forces, Japan, and Commander, 5th Air Force, on Aug. 1; **Maj. Gen. Robert A. Breitweiser** will become Vice Commander, Military Airlift Command, on Aug. 1; **Lt. Gen. William W. Momyer** became Dep. Commander, Military Assistance Command, Vietnam, for Air Operations and Commander, 7th Air Force, on July 1; and **Col. Paul R. Stoney** became Vice Commander, Air Force Communications Service, on July 1.

New assignments in the Air Force Systems Command are: **Lt. Gen. L. I. Davis,** Commander, National Range Div., additional duty as DOD Manager for Manned Space Flight Support Operations, effective Sept. 8; **Maj. Gen. Andrew J. Kinney,** Commander, Air Proving Ground Center, Aug. 1; **Maj. Gen. John L. McCoy,** Commander, Ballistic Systems Div., Aug. 1; **Brig. Gen. Arthur W. Cruikshank, Jr.,** Dep. Commander for Minuteman, Ballistic Systems Div., Aug. 1; **Brig. Gen. John S. Chandler,** Asst. Dep. for F–111, Aeronautical Systems Div., Sept. 1; **Brig. Gen. Gustav E. Lundquist,** Commander, Systems Engineering Group, additional duty as Dep. Commander, Research and Technology Div., Aug. 1; **Brig. Gen. Thomas S. Jeffrey, Jr.,** Vice Commander, Aeronautical Systems Div., Sep. 1; and **Col. Walter R. Hedrick, Jr.,** Dep. Commander for Space, Air Force Systems Command.

New assignments in the Air Force Logistics Command are: **Maj. Gen. Lewis E. Lyle,** Dir. of Maintenance Engineering, Air Force Logistic Command; **Brig. Gen. Leo P. Geary,** Dep. Commander, San Antonio Air Materiel Area; and **Brig. Gen. Clarence J. Galligan,** Dep. Commander, Sacramento Air Materiel Area.

Maj. Gen. Thomas G. Corbin has been assigned as Commander, Special Air Warfare Center, Tactical Air Command, effective Sept. 1.

OMEGA—A World-wide Navigation System

by
Capt. M. X. Polk, USN

One of the most urgent needs of a modern, far-ranging Navy is a truly world-wide navigation system—one that can be used at all times and under all conditions, and that can give accurate, reliable fixes in a few seconds. Such a system is needed for stationing ships and submarines, for locating unknown targets reported by barrier patrols and picket ships, and for controlling fleets spread over many miles of oceans. It is needed for navigating in the difficult regions around the poles, for submarine cruising under and for aircraft flying above the polar icepack, as well as for ships operating in the higher latitudes and in other areas not currently covered by electronic navigation systems. Such a system has been developed by the Navy and is currently being evaluated under the direction of the Chief of Naval Material. It is known as the OMEGA Navigation System.

To be most effective, a world-wide navigation system must have four attributes: reliability, accuracy, long range and flexibility. Its reliability should be such that it is useable at all times of day or night. Its accuracy must be equal to demanding operational needs. Its range should enable it to cover the entire globe, preferably with overlapping or redundant coverage in areas in which most operation may be expected. To be most economical, this coverage should be achieved with a minimum number of stations. To provide maximum utility, a single navigation system should be useable by surface ships, aircraft and completely submerged submarines. It is the objective of OMEGA to do all of these to a degree that reflects the maximizing of system cost effectiveness.

Just what is OMEGA? OMEGA is in many ways similar to LORAN, which has provided reliable navigation over parts of the world for 20 years or more. The new system, however, operates at the very lowest radio frequencies where radio propagation covers thousands of miles with exceptional reliability. As in LORAN, there will be a number of stations sending signals that agree in time to a millionth of a second, but OMEGA will need only eight stations for world-wide coverage whereas the 100 or more LORAN stations serve only a fraction of the earth's surface. The signals from these eight stations, when compared with each other, will define an electromagnetic grid, somewhat like the lines of latitude and longitude on the surface of the earth. This grid can be measured in several ways including techniques of the future that have not yet been invented.

How does OMEGA work? Basically, it is a time-shared system. Each transmitting station transmits a pulse at a given time in a pre-arranged frequency, then waits for the other synchronized stations to transmit their pulse in turn. Each pulse is slightly different in length to aid in recognition at the receiver. The navigator's receiver will receive the pulses from those stations within range, automatically measure the phase difference of the carrier from pulse pairs and indicate on direct reading dials or counters the phase difference measured. When integrated over a number of pulses, the phase difference measurement becomes extremely accurate, and fixes with average accuracies of a mile or better can be obtained at maximum ranges from the transmitting stations. The circuitry developed to provide such accurate phase measurements makes use of modern signal processing techniques and allows operation at fractional signal-to-noise ratios; that is, when the OMEGA signal is much smaller than the atmospheric noise, it may still be received and utilized for the phase information it contains.

Capt. M. X. Polk, USN, is Project Manager for the OMEGA Navigation System. His prior assignments were Head of the Surveillance, Navigation and ECM Branch, Bureau of Ships, and as Naval Weapons Liaison Officer with the Advanced Research Projects Agency. Capt. Polk holds a B. S. Degree in Chemical Engineering from Clemson College and a doctorate from Lehigh University.

In 1966 three stations at permanent sites will be in continuous operation, although with less than full power. One other lower-power station at Forrestport, N.Y., will be used on an interim basis. This network will be used for operational development and for an operational evaluation of new receivers now being delivered. At a future date the Forrestport, N.Y., station will be replaced by a permanent station. These four stations will then provide from approximately 0° -90° N and 0° -180°W, thus providing navigation in all waters adjacent to the U.S. coasts as well as the United States itself.

A technical data collection program involving surface and submarine forces has been under way since 1961. Tests conducted as part of this program indicate that a relative fix accuracy of less than 450 yards is attainable and that an absolute accuracy of one-two miles can be realized with an operational OMEGA system.

Significant accomplishments have been achieved in the development program. Experiments in the late 1950's and early 1960's have shown that the stability and predictability of propagation in the Very Low Frequency (VLF) 10-14 kc band over long ranges are very suitable for a navigation system. Feasibility of the system at sea has been proven in operational exercises involving numerous naval units over significant periods of time. At sea, use has also been demonstrated by Coast Guard and foreign ships. This has been done in Atlantic, Pacific and Caribbean waters. Receivers have been designed and test-flown in aircraft. Results from U.S. Navy flights in South American, Asian, South Pacific, Caribbean, Continental United States and the Arctic areas have demonstrated conclusively that the system is suitable for air-

craft use. The Royal Aircraft Establishment has also been investigating VLF navigation for commercial aircraft and has reached similar conclusions as a result of its test program. Working closely and actively with it, the Federal Aviation Agency is engaged in a program which will optimize the use of VLF navigation aids for commercial aircraft.

The feasibility of the use of VLF navigation in ships, low-performance (propellor driven) aircraft and completely submerged submarines has been proven, and engineering development work for stations and receivers has been completed for a general purpose navigation system having accuracies of one or two nautical miles. Such a system could now be implemented. However, during the development program it was realized that the system had greater potential than could be seen at the beginning. As a result, development of receiving equipment for supersonic single place aircraft has recently been undertaken. This equipment will include a computer which will read out latitude and longitude and other navigation information. The requirement for a navigator is thus eliminated. Studies have shown that the ambiguities of phase measuring navigation systems can be eliminated. Therefore, an engineering effort has been started to demonstrate the validity of these studies.

The OMEGA system will also provide world-wide standard frequency broadcasts. With its all-weather, full-time, world-wide coverage, and the inherent stability of transmissions in the VLF range, the OMEGA system is ideal for such a purpose. The four station network, which will be operating in 1966, will be synchronized to the ultra-precise Naval Observatory time and frequency standard, as well as having three atomic frequency standards at each station.

OMEGA is designed so that receivers may be operated automatically for maximum convenience and reliability, or manually for minimum cost. Signal format is such that receivers can cost from as little as $1,000 to a maximum dictated by user convenience requirements. Every effort has been made to foresee the techniques and requirements of the future and to design the system so that it will be useful for many years to come.

This, then, is the OMEGA Navigation System—a system with a future of valued, versatile and efficient service to surface ships, submarines and aircraft of the United States and her allies. Although there are some R&D efforts for system improvement, OMEGA is presently capable of being implemented as the first world-wide, man-made navigation system. An OMEGA Navigation System Project Management Office (PM-9) has been established under the Chief of Naval Material. This office directs, coordinates and serves as a focal point for all efforts concerning the development, evaluation, implementation and operation of the OMEGA system. Although the Navy has sponsored the development of this system, it becomes apparent that future operations will require the close cooperation of many agencies in the United States and several other countries. The Federal Aviation Agency, in rather close collaboration with the British Ministry of Aviation, assumes responsibility for determining the feasibility of OMEGA for civil aviation and especially for the guidance of the supersonic transport of the next decade. The Air Force has loaned the Forrestport transmitting station and an aircraft for flight evaluation tests; the Army has supported tests of the capability of OMEGA for helicopter navigation. The Navy will operate the transmitting stations during a three- or four-year period of development and testing. After the system becomes fully operational, it is planned that the Coast Guard will assume responsibility for operating all of the transmitting stations.

DEFENSE PRIME CONTRACT AWARDS TO SMALL BUSINESS

(Amounts in Thousands)

	July 1965—April 1966	July 1964—April 1965
Procurement from All Firms	$25,737,577	$20,020,718
Procurement from Small Business Firms	5,592,782	4,052,136
Percent Small Business	21.7	20.2

Navy Guide Available From G.P.O.

A new publication of the Naval Material Command, the "Guide for the Preparation of Proposed Technical Approaches (PTA)," NAVMAT P3910A, is available for purchase from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. The price is $1.50 per copy.

The purpose of the publication is to provide guidelines for the preparation of Proposed Technical Approaches (PTA) documents and an explanation of the need for the information required therein. The guide is organized into 12 sections which parallel the Proposed Technical Approaches format required by existing Navy directives. At the end of each section a check list is provided to emphasize the major points which should be covered in the section concerned.

The new guide is a companion to the "Guide for the Preparation of Technical Development Plans (TDP)," NAVMAT P 3910, dated July 1965, which can also be obtained from the Government Printing Office for $1.75 per copy.

USAF Report on Tactical Air Capabilities Available Thru DDC

A report classified Secret, covering a study on Air Force tactical air operations and problems made by the Air Force Scientific Advisory Board, is available to DOD contractors with required "need to know" and security clearance through the Defense Documentation Center (DDC). It is titled "Air Force Review of USAF Scientific Advisory Board Tactical Air Capabilities Task Force Final Report." The DDC order number is AD-372 744.

This document combines some 150 Scientific Advisory Board conclusions and recommendations contained in its report completed in June 1965 and the Air Force comments which were forawarded to the board in January 1966. The report covers the following areas: aircraft, logistics, reconnaissance, avionics, command and control, weapons and munitions, test and evaluation, meteorology and engineering geology.

Authorized DOD contractors and grantees may request this document from:

Defense Documentation Center
Cameron Station
Alexandria, Va. 22314

Government Agencies Seek Innovations in Education and Training

by
Roy K. Davenport
Dep. Asst. Secretary of Defense (Manpower, Planning and Research)
Office of Asst. Secretary of Defense (Manpower)

Government officials challenged industry to apply its advanced technologies and problem-solving capabilities in improving the quality of education and training at the Conference on Engineering Systems for Education and Training held in Washington, D. C., on June 14 and 15. The conference was sponsored by the Defense Department with the participation of the Office of Education and in affiliation with the National Security Industrial Association.

Much more stimulating and productive than had been anticipated, the conference was attended by over 500 representatives of industry and 250 Federal officials, both military and civilian. For the benefit of those who attended and for other interested readers of the *Bulletin*, in this article I would like to emphasize several points made during the conference. A complete transcript of the proceedings will be available in August through the National Security Industrial Association.

To begin with, the cost of individual training of the Military Establishment amounts to $4 billion annually. Of this amount $2 billion is spent on training of enlisted men of which half is used for basic military training. These figures suggest that even small improvements can produce very significant dividends to our military readiness and we seek industry's ideas in developing better management techniques, individual motivation, selection techniques and reduction of attrition rates.

After basic training, the enlistee must become proficient in one or more of some 1,500 skill areas. Only 12 percent of our men fire weapons, while 50 percent are trained in technical skills. Our basic training investment in the enlistee is about $1,200. Skill training requires an additional investment of from $2,000 to $12,000 per man. However, since our first term reenlistment rates are only 20 percent, we must optimize time spent in training versus time spent on the job to get a return on our investment.

In addition to training our enlisted men, we must provide continuous education for our 325,000-man officer corps. About 65,000 officers engage in some form of professional education each year at a cost of $400 million. Others are involved in costly training programs. Pilot training, for example, costs about $1 billion a year ranging from $250,000 for a jet pilot to $45,000 for a helicopter pilot. Here we want to know whether or not more use should be made of university advanced courses, whether some education and training courses can be reduced in time, and whether off-duty education through self-instructional techniques is desirable.

Costs of other Defense training includes $90 million for secondary overseas schools for military dependents. Additional costs are incurred to operate 33 correspondence schools.

I feel that industry, as an employer, will recognize it has a high stake in the quality of military education and training. Ninety-six percent of our enlisted men and 84 percent of our officers retire in time to have second careers in civilian life. About 16 percent of our nation's total work force has obtained vocational training in the Armed Services. In a very real sense industry has a vested interest in the type, magnitude and quality of the training which we provide for some of its future employees.

Besides contributing to the nation's total manpower pool, the Defense Department can play an important role which is highly relevant to evolution of the education technology industry. To the extent that we promote innovations in education and training, DOD offers itself as a huge laboratory to facilitate translation of education research into education technology. This underlies our desire to work closely with demonstration centers in universities and with the emerging "education industry." In his keynote response Dr. J. Sterling Livingston of Harvard University, a speaker at the conference, cogently remarked:

"Heretofore, the industry has been unable to find within our educational establishment the opportunity needed to demonstrate the effectiveness of its advanced technology. . . . Our public school systems have not been in a position to be responsive to bold new experiments in education. Industry often has been thwarted in taking initiative and frustrated in its efforts to find a market for its new concepts. . . . This conference underscores the fact that, whereas our education establishment may be slow in responding to advances in technology, our Military Services are leaders in applying new techniques in the classroom. . . . Our Federal Government is now creating through the Office of Education, the Department of Labor, the Office of Economic Opportunity and the Department of Defense a new opportunity for the education technology industry to demonstrate the value of its innovations and to gain support for research and development."

While we are proud of the progress which we have made in training through the applications of advanced technologies and management concepts in the Defense Department, we are constantly seeking new solutions to old training problems. I believe that industry will find real opportunities to apply the full range of its expertise—from research and development, to prototype, to final production—in particular areas. Herein lies the opportunity for development of new ideas, techniques and equipment and the demonstration of their effectiveness not only to the military but also to school systems, industrialists and other consumers in the education market.

The Defense Department is anxious to consider industry's proposals in helping us achieve the five objectives we are setting:

• First, we need to systematically challenge course content to make certain that it is directly correlated with on-the-job performance requirements, and geared to the minimum mental level which can perform the task with full satisfaction. With about 2,700 courses given to 1.8 million students

(*Continued on page* 13)

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SEPTEMBER 1966

SPEAKERS CALENDAR

DEPARTMENT OF THE ARMY

Hon. W. Brewster Kopp, Asst. Secretary of the Army (Financial Management), at Army Comptrollership School Commencement, Syracuse, N. Y., July 29.

Brig. Gen. Lloyd B. Ramsey, Dep. Chief of Information, at 9th Infantry Div. Reunion Dinner, Shoreham Hotel, Washington, D. C., July 30.

DEPARTMENT OF THE NAVY

RAdm. Henry H. Caldwell, Commander, Fleet Air Jacksonville, at Douglas Aircraft Co. Management Club Meeting, Sacramento, Calif., Sept. 21.

Hon. Paul H. Nitze, Secretary of the Navy, at Institute of Electrical and Electronics Engineers Convention, Washington, D. C., Oct. 3.

Mr. Paul R. Miller, Asst. for Quality Control, Special Projects Office, at American Institute of Engineers Region Two Conference, Atlantic City, N. J., Oct. 13.

DEPARTMENT OF THE AIR FORCE

Maj. Gen. B. I. Funk, Commander, Space Systems Div., Air Force Systems Command, at California State College, Long Beach, Calif., Aug. 8.

Gen. J. P. McConnell, Chief of Staff, USAF, at Cheney Award Luncheon, Washington, D. C., Aug. 9. (Appearance only); at Defense Orientation Conference Assn. Meeting, Washington, D. C., Sept. 30.

Gen. H. M. Estes, Commander, Military Airlift Command, at National Defense Transportation Assn. Meeting, Atlanta, Ga., Aug. 11.

Hon. L. Marks, Jr., Asst. Secretary of the Air Force (Financial Management), at CPA Society Meeting, Los Angeles, Calif., Sept. 12.

Gen. G. P. Disosway, Commander, Tactical Air Command, at Chamber of Commerce Meeting, Oklahoma City, Okla., Sept. 16.

Maj. Gen. H. E. Humfeld, Commander, 1st Strategic Aerospace Div., at National Security Industrial Assn. Meeting, Vandenberg AFB, Calif., Sept. 23.

Lt. Gen. T. P. Gerrity, Dep. Chief of Staff, Systems and Logistics, at U. S. Air Force Institute of Technology Symposium, Sunnyvale, Calif., Oct. 5.

DIPEC Standards Improve Property Management

Two primary responsibilities assigned to the Defense Industrial Plant Equipment Center (DIPEC), in Memphis, Tenn., are to maintain master property records of DOD-owned industrial plant equipment (IPE) and to redistribute idle IPE.

High value items of DOD-owned equipment such as IPE are individually controlled and managed through a system of property records which provides a means for maintaining continuous visibility over such information as location, program use, age, condition and cost. Good descriptions are of critical importance to property management at all levels and to effective redistribution when property becomes idle.

DIPEC is developing standards for describing IPE which Defense activities can use in preparing property records for their own management uses and for reporting idle IPE to DIPEC. These standards will improve communications among Defense activities and between Defense activities and their contractors. Of equal importance is their adaptation to mechanized processing of information, thus reducing administrative workloads and costs. Many large private companies have adapted, or are in the process of adapting, these standards to their own management improvement programs.

DIPEC standards are published in handbooks listed below with the number, title and Federal Supply Classification (FSC):

DSAH 4215.1—Electrical and Electronic Properties Measuring and Testing Instruments, FSC 6625, $1.25.

DSAH 4215.2—Woodworking Machines, FSC 3220, $0.75.

DSAH 4215.3—Supplement to Production Equipment Directory D1 Metal-Working Machinery 1960 Revision, FSC 3411 thru 3419, 3441 thru 3449, $2.00.

DSAH 4215.4—Industrial Furnaces and Ovens, FSC 3424, 3655, 4430, Volume 1, $2.25; Volume 2, $1.75.

DSAH 4215.5—Material Handling Equipment and Lifting Electro-Magnets, FSC 3815, 3910, 3920, 3930, 3950, 3990, Volume 1, $1.50; Volume 2, $1.50.

DSAH 4215.6—Physical Properties Testing Equipment, FSC 6635, $1.75.

DSAH 4215.7—Wrapping and Packaging Machinery, FSC 3540, $0.60.

DSAH 4215.8—Textile Industries Machinery and Industrial Sewing Machines, FSC 3520, 3530, 3625, $0.45.

DSAH 4215.9—Distribution and Power Station Transformers, FSC 6120, $0.65.

DSAH 4215.10, Environmental Chambers, FSC 6636, $0.70.

DSAH 4215.11—Power Conversion Equipment, Electrical, FSC 6130, $0.65.

DSAH 4215.12—Rolling Mills, Drawing Machines and Metal Finishing Equipment, FSC 3422, 3426, $1.50.

DSAH 4215.13—Portable Machine Tools and Toolroom Layout Plates and Tables, FSC 3450, 3460, 5220, $1.00.

DSAH 4215.14—Compressors and Vacuum Pumps, FSC 4310, $1.25.

DSAH 4215.15—Liquid and Gas, Pressure, Temperature, Humidity and Mechanical Motion Measuring and Controlling Instruments, FSC 6680, 6685, $0.65.

DSAH 4215.16—Crystal and Glass Industries Machinery, FSC 3635, $0.45.

DSAH 4215.17—Driers, Dehydrators and Anhydrators, FSC 4440, $0.45.

Distribution of the handbooks has been made through normal channels to defense contractors and to military activities. Defense contractors who have not been furnished copies of the handbooks for use in managing Government-owned IPE should request them through their appropriate Government representatives. The handbooks may also be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at the cost indicated in the listing.

Other handbooks are in the process of being published or being prepared for publication. Notice will be given when they are available.

CALENDAR OF EVENTS

Aug. 13–14: Greater Cleveland Air Show, Burke-Lakefront, Cleveland, Ohio.

Aug. 23–26: Institute of Electrical and Electronics Engineers Western Electronic Show and Conference, Los Angeles, Calif.

Aug. 29–31: Institute of Electrical and Electronics Engineers Ocean Electronics Symposium, Honolulu, Hawaii.

Sept. 2–5: Canadian International Air Show, National Exhibition Park, Toronto, Ontario, Canada.

Sept. 5–11: National Championship Air Race, Reno, Nev.

Sept. 11–16: American Chemical Society Meeting, New York City.

Sept. 13–15: National Security Industrial Assn-U. S. Air Force Electronics Conference (Secret), Murray Hall, U. S. Naval Station, Boston, Mass.

Sept. 14–16: Annual Air Force Assn. Fall Meeting, Sheraton Park Hotel, Washington, D. C.

Sept. 17–18: Midwestern Aviation and Space Exposition, Willow Run Airport, Detroit, Mich.

Sept. 19–20: Government-Industry Procurement Clinic, Portland, Ore.

Sept. 22–23: Government-Industry Procurement Clinic, Seattle, Wash.

Sept. 26–28: Sixth Annual National Conference on Environmental Effects on Aircraft and Propulsion Systems, U. S. Naval Air Turbine Test Station, Princeton, N. J.

Sept. 28–29: National Security Industrial Assn. Marine Geodesy Symposium, Columbus, Ohio.

Oct. 10–12: 1966 Assn. of the U.S. Army Meeting, Sheraton-Park Hotel, Washington, D.C.

SMC—AMC Consolidated

The U. S. Army Supply and Maintenance Command (SMC) was merged with the Army Materiel Command (AMC) on July 1 placing direct control of field installations and activities, formerly under SMC, under AMC. The merger will clarify command responsibilities, expedite the decision-making process, and provide a more cohesive and responsive organization with focus on the development and support of materiel to meet requirements of the field forces.

A physical regrouping of the two headquarters last year in the Washington, D.C., area has facilitated the consolidation. Staff elements were relocated to bring together elements doing similar functions. The consolidated AMC will continue to be housed in Building T-7, the Nassif Building, and the Naval Weapons Plant.

MEETINGS AND SYMPOSIA

AUGUST

Electron Spin Resonance Spectroscopy Seminar, Aug. 1–3, at Michigan State University, East Lansing, Mich. Sponsors: Army Research Office-Durham, Atomic Energy Commission, American Chemical Society and Michigan State University. Contact: Dr. David R. Squire, Chemistry Div., Army Research Office-Durham, Box CM, Duke Station, Durham, N. C., 27706, (Area Code 919) 286–2285.

1966 Linguistic Institute Conference on **Linguistic Method**, Aug. 1–3, at the University of California at Los Angeles. Sponsor: Air Force Office of Scientific Research. Contact: R. W. Swanson (SRI), Air Force Office of Scientific Research, Washington, D. C. 20333, (Area Code 202) OXford 6–5374.

Eleventh International Symposium on **Combustion**, Aug. 14–20, at the University of California, Berkeley, Calif. Co-sponsors: Ballistic Research Laboratory and the Combustion Institute of Pittsburgh, Pa. Contact: Dr. R. J. Heaston, Physical Sciences Div. Army Research Office, 3045 Columbia Pike, Arlington, Va., (Area Code 202) OXford 4–3465.

Second **Computer & Information Sciences** Symposium on **Learning, Adaptation and Control in Information Systems**, Aug. 22–24, at Columbus, Ohio. Sponsors: Office of Naval Research, Battelle Memorial Institute and Ohio State University. Contact: Julius T. Tou, COINS Co-Chairman, Director, Communications Science Research Center, Battelle Memorial Institute, Columbus, Ohio 43201.

Application of Generalized Functions to System Theory Conference, Aug. 25–26, at the State University of New York, Stony Brook, N. Y. Co-sponsors: Air Force Office of Scientific Research and Society for Industrial and Applied Mathematics. Contact: Capt. John Jones, Jr. (SRMA), Air Force Office of Scientific Research, Washington, D. C. 20333, (Area Code 202) OXford 6–1302.

Unguided Rocket Ballistics Symposium, Aug. 30–Sept. 1, at Texas Western College, El Paso, Tex. Sponsor: Army Electronics Research & Development Agency. Contact: V. C. Cochran, Army Electronics Research & Development Agency, White Sands Missile Range, N.M., 88002.

SEPTEMBER

U. S. National Committee for **Pure and Applied Biophysics** in connection with Second International Biophysics Congress, Sept. 5–9, in Vienna, Austria. Sponsors: Office of Naval Research and National Academy of Sciences-National Research Council. Contact: Mrs. P. H. Tenniswood (Code 444) Office of Naval Research, Washington, D. C. 20360, (Area Code 202) OXford 6–1538.

Twelfth Annual Seminar of the American Society for **Industrial Security**, Sept. 20–22, at Sheraton Hotel, Philadelphia, Pa. Sponsor: American Society for Industrial Security. Contact: J. L. Graves, Public Relations Chairman, P. O. Box 8417, Philadelphia, Pa. 19101, (Area Code 215) 823–3747.

Symposium on **Gastrointestinal Radiation Injury**, Sept. 25–28, at Richland, Wash. Co-sponsors: U. S. Atomic Energy Commission and Battelle-Northwest. Contact: Dr. Maurice F. Sullivan, Biology Dept., Battelle-Northwest, P. O. Box 999, Richland, Wash. 99352.

Symposium on **Galio-Marinide**, Sept. 26–27, at Wales and England. Sponsor: Research and Techonolgy Division, Air Force Systems Command. Contact: R. W. Runnells (AVN), Air Force Avionics Laboratory, Research and Technology Div., Air Force Systems Command, Wright-Patterson Air Force Base, Ohio 45433, (Area Code 513) 253–7111, ext. 53802.

Sixth Annual National Conference on **Environmental Effects on Aircraft and Propulsion** Systems, Sept. 26–28, at the Nassau Inn, Princeton, N. J. Sponsor: U. S. Naval Air Turbine Test Station. Contact: Dennis A. Wysocki, Conference Vice-Chairman, U. S. Naval Air Turbine Test Station, P. O. Box 1716, 1440 Parkway Ave., Trenton, N. J. 08607, (Area Code 609) 882–1414, ext. 355.

Sixth Symposium on Naval **Hydrodynamics, Maneuverability, Waves and Physics of Fluids**, Sept. 29–30, Oct. 3–4, at the Statler Hilton Hotel, Washington, D. C. Sponsor: Office of Naval Research. Contact: S. W. Doroff or P. Granville, Office of Naval Research, Code 438, U. S Department of the Navy, Washington, D. C. 20360, (Area Code 202) OXford 6–1433 or OXford 6–6839.

AOA Annual Meeting Scheduled

The 48th Annual Defense Preparedness Meeting of the American Ordnance Association will be held in Los Angeles and at Edwards AFB, Calif., on October 5-6, 1966. The U. S. Air Force is the host Military Service at this year's meeting.

The meeting is designed to provide an opportunity for Air Force representatives to discuss "Military Aircraft of the Future" before an audience of representatives from the aircraft and related industries and to allow these representatives to see the newest aircraft of the Air Force in both static and aerial displays.

FROM THE SPEAKERS ROSTRUM

Address by Mr. James W. Roach, Asst. Dir. (Engineering Management), Office of Dir. of Defense Research & Engineering, at the DOD Advanced Planning Briefings for Industry, San Francisco, Calif., April 12, 1966.

James W. Roach

Management Trends in Defense R&D

Research and development is a major Defense program. Through this program the DOD obtains the weapons and systems needed by the Military Services, as well as the technology and building blocks these major systems depend upon.

Obviously a program that costs $7 billion a year, and has more than 100 major projects important to national defense, demands and receives continuing management attention. Part of that attention is to assure that the policies we establish and use fit well with the practical business of developing and producing hardware. I will talk to you about that part of our management review that may result in some modification of current policies. Some of these possible changes in policies could affect the way you do business with the DOD.

Some of the policy changes we are considering aim at preventing future problems. Others relate quite directly to our day-to-day activities. I will describe both kinds of problems and the actions we are taking to solve them. These actions, when analyzed and related to each other, provide insight to the management trends in Defense R&D.

Like our counterparts in industry, we have a continuing need to improve how the top R&D echelon—or corporate level—manages the efforts of subordinate activities. This problem extends through all levels of Defense R&D management, but I think you will be most interested in two specific and closely related parts of the problem:

- The management of the Defense in-house R&D activity.
- The management of the R&D effort provided by industry. A separate, more general problem is how to improve the R&D response to short-range user needs, such as those arising in Vietnam.

Considering your interests, I will amplify two of the problems: "Management of Contract R&D" and "Response to Vietnam." However, to set the stage I will first describe certain actions being taken to solve part of the problem of "Management by Top R&D Echelons." These actions can be summarized as better expression of intent in three areas:

- Improved definition of the job to be done.
- More effective selection of the optimum contractor.
- Improved control of the defined contract.

Improved definition of the job has been emphasized by contract definition preceded by concept formulation. This policy was released by DOD Directive 3200.9. Concept formulation is the process for answering the necessary questions regarding alternate operational approaches and alternate technical solutions, as well as the cost and operational effectiveness of these approaches and solutions. Concept formulation is the basis for the prime management decision—should the project enter engineering development, considering that the objective of engineering development is development with strong intent for deploying to operational inventory? This is a key decision, with significant military and resources implications. Therefore, the concept formulation must be comprehensive and searching, yet very timely.

Contract definition is both the validation action and the action required for precise definition of the contract. Contract definition does not mean the over-definition of the details of the system to be developed but rather the precise definition of the performance of the system and the contract to achieve that performance.

To date, 14 major projects have passed through some type of contract definition: five Air Force projects, six Navy, and three Army. These projects include such systems as Titan III, Lance, MACS, IHAS and ILAAS, Mark 48 Torpedo, C–5A, AAFSS and Poseidon. Not all of these contract definitions have gone smoothly nor have all achieved the objectives established for contract definition. We have learned that the concept is good but occasionally the implementation is lacking. Our future action will be directed toward improving the implementation. Currently, contract definition is planned for FDL, Mark II Avionics and SAM–D.

More effective contractor selection follows logically from the contract definition effort. Contract definition attempts to give the competitors the best possible avenue for "displaying their wares." Our source selection policy, released in DOD Directive 4105.62, attempts to establish the best possible climate for judging the contractors' "wares" against DOD needs. The source selection policy brings in all affected parties to the decision—developer, user, logistician, financier; the policy provides checks and balances through both specialist and generalist participation.

Several of the projects which have gone through contract definition have

also utilized the recently-released source selection policy. Particularly satisfying have been the source selection efforts of the Navy's Condor and Walleye, the Army's AAFSS and the Air Force's C–5A.

Following contractor selection, we all need to exercise improved control of the defined job. Key to this control is the control exercised by the contractor through the high motivation contract negotiated as an output of contract definition. To supplement, but not constrain the contractor, the DOD is developing a revised policy on configuration management and on the performance measurement system to be used to monitor the development and production effort. Configuration management is a discipline being developed to strike the proper balance between the latitude necessary to the developing contractor and the needs of the DOD for precise definition of the configuration. We are attempting to balance these apparently conflicting needs by a gradual increase in the details of configuration definition as the design effort progresses.

Let's turn to an analysis of the management of contract R&D. For the past few years, emphasis has been placed on contracting for development by means of performance specifications. This may be through the use of system performance specifications or performance specifications for the major elements of the system, or through a combination. Here again we must exercise caution. There is a natural tendency to specify design details of the system elements, thereby destroying design latitude. In addition, certain other techniques such as pre-contract detailing of the functional requirements of each element may defeat the objectives of contracting by overall performance specifications.

Configuration management fortifies the performance specification concept for development. As presently conceived, it utilizes a progressively more detailed definition of configuration as design and test proceeds. Control of the configuration at any point in time will be exercised against the configuration identification developed to that point.

Our current revision efforts on CITE (Contractor Independent Technical Effort) have, as a prime objective, improved capabilities from contractor independent R&D. This objective will be achieved through increased contractor latitude to select those CITE projects which will enhance his own R&D efforts and, therefore, his responsiveness to DOD. These CITE projects may range (at the contractor's discretion) from independent research efforts through development to bidding and proposed efforts on a solicited or unsolicited basis. We hope to foster this latitude by providing a more equitable means of negotiating a reasonable ceiling for total CITE funds within which the contractor may exercise his management judgment on project selection.

The Weighted Guidelines for Profit Determination is an action which tends to improve the management of Defense acquisition by rewarding high contract performance and conversely penalizing for poor performance. Results to date indicate a significant increase in as-negotiated profit rates. Using a base period of 1959 through 1963, significant increases have occurred in as-negotiated profit rates for 1964 and 1965. It is too early to have statistically significant facts on realized profit—either as a percentage of sales or as a percentage of investment. Similarly, it is too early to determine whether DOD is getting improved performance for these increased, as-negotiated profit rates. However, close attention is continuing on the profit rate picture.

I mentioned earlier that the key to improved management of contract R&D is the motivation provided by a well-defined contract with the proper incentives built in. DOD actions to achieve well-defined contracts with proper incentives are well known. There have been some successes and there have been some failures. We continue to press for better implementation of the incentive concept. More than half of our engineering and operational systems developments utilize some form of incentive contracts. Lesser use is appropriate and evident in the less clearly defined effort that takes place in the earlier development categories and in research.

A recent problem concerns team arrangements made for the proposal effort and the development of a particular project. Certain actions by DOD have been interpreted as a policy change against team arrangements. This problem has been brought to the attention of the top management levels in the OSD and in the Services. It appears that a policy statement is needed that would recognize the validity and desirability of team arrangements, and would establish the general rule that team arrangements will be honored subject to the DOD right to direct specific substitution of a team member for a specific, substantive reason.

The Total Package Procurement concept is being tested on three major projects: the C–5A, the FDL Transport and SRAM. I would like to use the concept as an illustration of an improvement in the management of contract R&D. There are many who feel that the follow-on production of a project is a greater motivation for improved performance than are higher profit rates in development. I believe there are many motivations, and total package should stimulate the follow-on production motivation as weighted guidelines attempts to stimulate the reputation—or image-motivation.

Another action under way to improve management of contract R&D is the development of CWAS, Contractor Weighted Average Share of Cost Risk. It is appropriate to point out that CWAS implementation should have a beneficial result on contract R&D management because of its promise of increased contractor management latitude via the operation of a highly motivating, cost risk environment.

Turning to the second problem area —R&D response to Vietnam—there are those who have expressed the concern that programming, contract definition, etc., may drastically constrain the response rate of R&D to short term user needs such as those of Vietnam. This is a concern of R&D management and several actions have been taken to increase the timeliness and effectiveness of R&D response. Most of these actions have been directed toward accelerating our current development concepts rather than starting a totally new management system for quick-reaction developments.

A closer tie in of the user's need and the R&D agency's proposed solution has been required for some time. On the larger, longer-term projects, the requirements of concept formulation and contract definition provide this needed link. For the short term needs, special arrangements are in use

to provide a quick-response interface between user needs and R&D proposed solutions.

Since 1964 there has been a Vietnam Joint Research and Test Activity (JRATA) established by the Joint Chiefs of Staff and the Director of Defense Research and Engineering. Its mission is to test and evaluate the combat potential of any new equipment. JRATA operates under the direction of Brigadier General John Boles who reports to General Westmoreland. General Boles' organization is making major contributions to our operational capability in evaluation of new hardware and particularly in operational employment studies of such equipment. An example of the latter is a recent effort by the Army element of JRATA which recommended a change in the Vietnamese artillery doctrine and increased its effectiveness by several times. . . .

This past year, General Westmoreland established a section within the MACV Command whose sole responsibility is to obtain from field commanders expressions of their urgent needs. There is a direct link from MACV to the Service R&D organizations. The Vietnam-need statements receive first priority over all other longer-term requirements. The Services have established streamlined procedures for processing and developing solutions to these needs. A regular exchange of information on requirements and their resultant R&D projects has been established. Four joint Service/ARPA technical teams (Mobility, Communications, Surveillance and Weapons) have visited Vietnam repeatedly for detailed analysis and evaluation. Last summer, MACV identified many problem areas. All have been reviewed to determine means of satisfying these needs. There are many projects, most of them previously in existence, aimed at satisfying these problem areas. We estimate that about 75 percent of these R&D problem areas will be satisfied by some item in operation by January 1967.

Coupled with these improvements in the requirements identification process and in the evaluation activity, there have been similar improvements in the R&D organizations—improvements which serve to increase the response rate. Two examples of improved R&D organizations are the Army's Limited War Laboratory in Aberdeen and the Air Force's Special Air Warfare Center at Eglin.

The war in Vietnam has many facets, varying from counter-insurgency against terrorists in the villages to combat against the organized regular army units from North Vietnam. There is an almost infinite variety of equipment required. Many examples can be mentioned ranging from the normal developments accelerated for Vietnam, such as the lightweight AR15 or M16 rifle and the M79 40mm grenade launcher, to the quick-response developments like the improved jungle boot. . . .

The Aberdeen Limited War Laboratory had been conducting some preliminary investigation of armor plating of commercial vehicles. In November 1964 the laboratory received a request from Vietnam for Armor Kits for the Scout vehicles (protection for the driver and passenger from small arms fire and mine fragments). The lab delivered 12 kits to Vietnam in June 1965, seven months after the initial request. . . .

This streamlined system for meeting the short-term needs is not yet complete. We are taking steps to improve further our communications with Vietnam to keep abreast of their problems and to tell them of our progress. In addition, we must marshal more of the potential contribution of the Defense R&D community.

These remarks on actions taken to solve R&D problems illustrate the management trends in Defense R&D. I can summarize these trends into three terse statements:

- Improved techniques for internal DOD development management.
- Increased contractor latitude when coupled with increased motivation.
- Improved response to short-range user needs.

Education and Training

(*Continued from page* 8)

each year, this research task is a mammoth undertaking. We need to start this program by perfecting the techniques for such assessments.

- Second, we must seek ways to communicate the necessary knowledge and skill to each student in the optimum period of time—neither too much nor too little. We believe it may be possible to reduce training time in many courses. A key technique is to give each individual in technical training a chance to proceed at his own pace. Use of this approach will require much greater automation and more sophisticated engineering techniques.
- Third, we need to expose more of our people to more information on an "as needed" basis. With devices for information storage and retrieval, random access and high speed communications, it seems to us that the time is fast approaching when knowledge can be more widely and immediately accessible—both for classroom training and for use on the job, thus minimizing the amount of knowledge which must be gained in the classroom itself.
- Fourth, we need to raise the standards in instruction to the highest level of quality and effectiveness by the use of pre-recorded instruction flowing from the best teachers and the best materials—communicated by tape, film, television, computers and other devices to students at multiple locations.
- Fifth, we need to apply planning and quality control techniques with rapid feedback to our teachers from on-the-job performance. Our quality controls should be comparable in precision to the techniques employed in the production of today's most sophisticated aerospace systems.

These are our objectives. We solicit the assistance of industry in engineering systems to achieve them.

In discussing the design of a truly creative partnership between Government and industry before a group of leading businessmen last May, President Johnson stated:

> **"There are numerous cases where the technology is already at hand but is awaiting a demonstration of its practicality and the creation of a market. One contribution the Federal Government can make is in helping to overcome the reluctance to accept promising innovations by making possible their demonstration and evaluation."**

This is the basis for our partnership approach with industry. The Defense Department seeks the assistance of industry in improving the effectiveness of our fighting forces. In turn, we in the Defense Department are anxious to provide industry the opportunity to innovate in this endeavor. And the nation on the whole will benefit.

Microelectronics: A Technological Revolution

by
Lt. Gen. W. A. Davis, USAF
Vice Commander, Air Force Systems Command

The new technology of microelectronics promises to change greatly the living patterns of future generations of Americans. Some of these changes are already beginning to influence the lives of many people today.

The tremendous progress of this new technology is a result of the nation's need to meet the complex electronic demands for advanced ballistic missile and space systems and avionics equipment. Indications are that the peaceful benefits of microelectronics may, in time, far out-distance its military applications.

Civilian benefits from this type of space-age research are virtually unlimited. Use of microelectronics in the home of tomorrow will include temperature-sensitive ovens that will cook a roast or bake a cake perfectly every time; and air conditioning and heating systems that will analyze the temperature and humidity at several points in a home to keep the rooms at a constant, desired level. High-volume home-entertainment circuitry is on the visible horizon, with the major channel of news, information and entertainment incorporated in a single integrated system and with a high-speed electronic printer for recording any information the viewer wishes to retain.

Applications in other areas may include wristwatch radios and TV sets, invisible hearing aids and desk-top computers. Pocket-size radio telephones may become commonplace in the not-too-distant future.

Microelectronics is a general term to describe a number of approaches for increasing reliability, while decreasing the weight and size of electronic equipment. In one, the components are diffused or grown into a silicon flake known as a "chip," and in another a thin film process is used for layering the components on the silicon chip. Microelectronics differs from microminiaturization in that the latter simply reduces the size of electronic components, while microelectronics utilizes several new techniques of circuits.

Integrated circuits are built by a specific diffusion construction technique which generally starts with the basic ingredient of ultra-pure silicon. Certain "impurities" with specific characteristics are added in controlled amounts and the mixture is grown into a material which, when properly excited, will perform a basic electronic function.

A dozen or more of the functions, or circuits, may be incorporated into a silicon flake chip no larger than the head of a pin. Up to 500 circuits can be placed in an area no larger than the eraser at the end of a pencil. One of these chips can perform the same work which would require a large number of electron tubes or transistors and perform it more reliably.

Floyd E. Wenger, a pioneer in the field of microelectronics who served as reliability assistant in the Systems Effectiveness Division of the Air Force Systems Command, compares the new technology with the technique used by a housewife when she takes various raw ingredients, mixes them in a ratio and processes them in a certain manner to produce a cake.

The housewife does not have to worry too much about the amount of impurities in the materials. This is not true, however, in the processing of integrated circuits. The materials used must be refined and purified until there is less than one part of impurity or contamination in a billion parts of the material.

The room in which the chips are grown and processed must be surgically clean. Any contamination upsets the chemical material balance and degrades the operational capability and reliability of the devices.

Since the active, transistor-like function and the other circuit components are an integral part of the chip, and in a homogeneous mass, the reliability of the chip becomes the reliability of the various materials used in the process and the extremely precise processing techniques involved in their manufacture. A great benefit of this new technology is that external connections, which are a great cause of unreliability and increased weight in circuitry employing conventional tubes, transistors, resistors and capacitors, are largely

This microcircuit equivalent of a six-transistor radio fits in the eye of a sewing needle. New combinations of materials—single crystal silicon on sapphire—are used to provide the required electrical isolation within the small area available.

eliminated by the integrated circuit.

Wenger is convinced that integrated circuit technology is a natural for use in the construction of digital, or counting-type circuits, such as those used in many computers and control devices. It lends itself to mass production; and the cost of chips containing from ten to fifty different electronic circuits is only slightly higher than the cost for single circuit devices.

Analogue, or measuring circuits, are not as far advanced from the application standpoint as the digital devices, but a rosy future is predicted for their ultimate use.

It is forecast that the majority of commercial computers and business machines will be using integrated circuits within a three-year period.

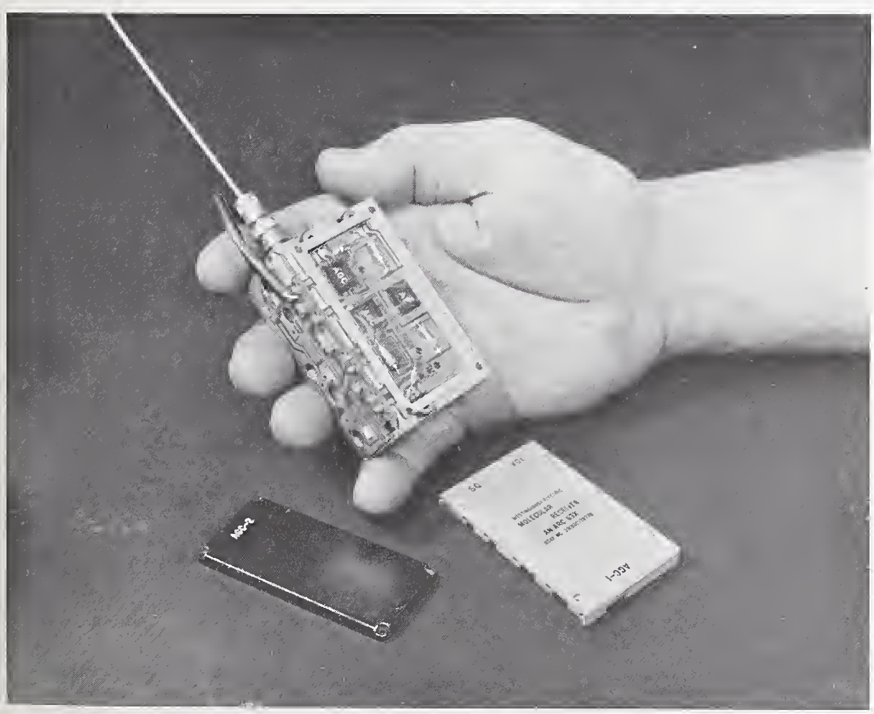
Calculator and adding machine companies are presently evaluating their practical applications. Their superiority will make them candidates for all types of instrumentation, data processing systems and machine equipment control, which involves programming a machine to handle a complete manufacturing or other process by electronic means.

Air Force involvement in microelectronics, which started Government/industry research in this new technology, came about through the development of highly sophisticated weapon systems.

By the mid-1950's, the space and global operations of the Air Force had become highly dependent upon electronic aids. These devices, built with techniques borrowed by the early radio pioneers from the electrical industry, were growing larger, heavier and more complex. At the same time they were becoming less reliable. This led to tremendous maintenance and logistic support problems.

It was at this critical period that the concept of microelectronic circuits emerged and was grasped by the Air Research and Development Command, predecessor of today's Air Force Systems Command, as a highly promising solution to the mounting problems.

The concept of molecular electronics, which is the use of a single block of material to perform the function of an entire circuit, came into being. This concept was proposed to industry by the Air Force and a contract was awarded for its exploitation in 1959. This stimulated an explosion of industry effort and resulted in the silicon integrated circuit.



The AN/ARC–63 communications receiver was the first non-digital equipment to make extensive use of integrated circuits—with a resulting 35 to 1 reduction in size and weight over a comparable transistor version of the same receiver.

Ultra-miniaturization is only a happy by-product of the new electronics, with reliability its main advantage. The guidance systems of the Minuteman II ICBM have proven the advantage of microelectronics, with a 50 percent weight reduction, an increased reliability factor of ten and a resulting decrease in maintenance costs.

The best data on transistors used in the first Minuteman missile system indicated failures on the order of one every 100,000 hours. Extensive life tests of the new integrated circuits indicate a failure rate of less than one every 20 million hours.

Experts indicate the life of electronics in a system will be as long or longer than many of the systems which contain them. If they can predict the failures, spares can be sent along with the new equipment. Self-identifying fault detectors can be built into the system to instantly recognize troubles, thereby lowering maintenance costs.

Beyond the measurable benefits are broader implications relating to operational system effectiveness. It is hard to attach a value to decreases in the "down time" of military aircraft or to the maintenance of ballistic missiles and bombers because force readiness and the maintenance of a specified force level are difficult to "cost." Microelectronics will give added performance efficiency and effectiveness to weapons capabilities.

The demonstrated success of integrated circuits in the Minuteman and other programs has led the Air Force to consider them for much wider applications. Consequently, the Air Force Systems Command is urging the maximum practical application of microelectronic devices in all new system and equipment designs, as well as for product improvement in existing equipment.

A report covering the development, growth and future of microelectronics has been published in booklet form by the Air Force Systems Command. It is titled, "Integrated Circuits Come of Age," and is available to industry representatives without charge.

Requests for copies should be sent to Air Force Systems Command, Attn. SCEP, Andrews AFB, Washington, D. C. 20331.

However, the three forms of study discussed here are conducted formally or informally to assure that pertinent factors are weighed into a decision. If these studies are too informal or superficial, or should be interfered with by organizational, bureaucratic, or procedural rigidity, or are sequenced improperly, the system will fault, and the proposal will suffer as a consequence. The sequence of these studies is not always predictable but generally tends to follow that given. The requirements-definition dialogue initiates activity; cost-effectiveness analyses generally come into play at an appropriate time after the dialogue has matured sufficiently; finally, technical cost tradeoffs phase into the activity.

R&D Effectiveness Quantification.

But to repeat our earlier question: When is the appropriate time for the application of cost effectiveness testing? And under what conditions can cost and effectiveness be tested constructively? We are now back to the original issue, namely, "Can the effectiveness of R&D be measured?" The answer to this question supplied at the beginning of this article was, "It depends."

It depends, as stated earlier, on the three characteristics of the materiel, namely:

- The conceptual maturity.
- The developmental maturity.
- The degree of operational uncertainty.

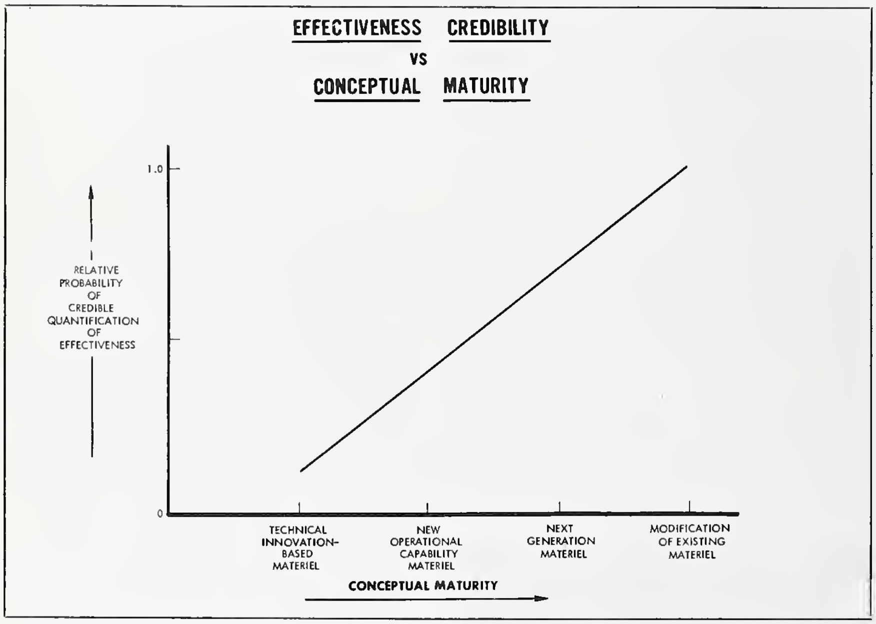


Figure 6.

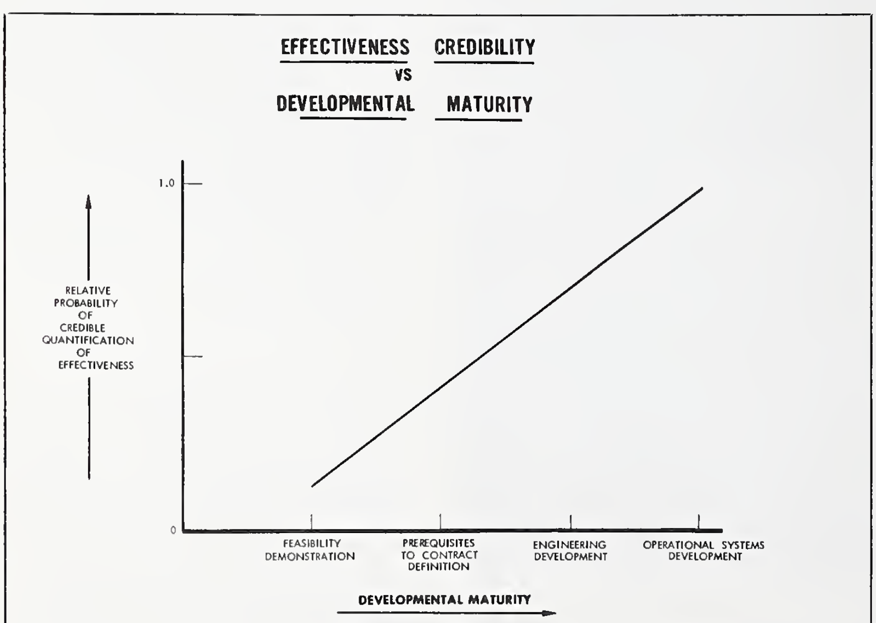


Figure 7.

Let's examine these characteristics in greater detail. Figure 6 is a qualitative representation of the relationship between the probability that the analyst can develop credible quantification of effectiveness against the conceptual maturity of the materiel. You will note that the probability of credible quantification increases as the character of the materiel moves away from the innovation environment toward the more mature and more quantifiable environment of next generation or existing materiel. This chart is strictly qualitative, intended simply to delineate the character of the relationship. The curve is probably not a straight line, for example, but this is incidental. You will recall from the foregoing that care must be exercised to protect innovative operational and technological concepts against premature effectiveness and cost inhibition. If indeed credible quantifications of effectiveness are hard to come by, for materiel concerned with innovational concepts or new operational capability, the probability of error is more likely in any derivative analysis than when effectiveness testing is concerned with materiel more conceptually mature.

Strong inference applied to the requirements definition process will confirm the validity of this relationship, so let's move on to the next characteristic of evolving materiel, namely, the developmental maturity.

Charted in Figure 7 is the relationship between probability of credible effectiveness quantification and the developmental maturity of materiel. Requirements definition again supports the validity of this qualitative relationship, namely, that there is a higher degree of uncertainty in effectiveness quantification prior to engineering for end use and that effectiveness quantification is more readily and credibly developed after the materiel is engineered with the objective of operational inventory. Again the definitive slope of the curve is incidental for our purposes.

Finally, let's examine the last characteristic of R&D materiel, i.e., the degree of operational uncertainty implicit in the genesis of the proposed materiel. Operational uncertainty is complex and intractable. To a great extent, this derives from the fact that the credibility of effectiveness quantifications is determined by the degree to which the component factors that make up these numbers can be controlled. And operational uncertainty is not readily amenable to control.

Let's go back for a moment to the problem monger and solution monger concept. But first let me recount a story that was used by a senior cost effectiveness analyst during a presentation on the utility of cost effectiveness in R&D. The analyst described a recipe he had seen for hassenpfeffer that was contained in a 19th century cookbook. The recipe opened with the inexorable logic—"First, catch a hare." Obviously, this is the first step. The analyst argued, nevertheless, that this was not the first step but a derivative of the earlier requirement, namely, the necessity of first getting the recipe to tell you to catch a hare. The analyst drew the analogy that, while it might appear that the obvious first requirement for cost effectiveness studies is to have something needing effectiveness measurement and costing, in reality that is not first. According to him, first there must exist the problem of choice. And to have a choice challenge, there must be alternatives.

The analyst stopped at this point, having illustrated his position. However, let's examine the sufficiency of this position in the case of combat materiel for a moment. If we can agree that effectiveness measurement is concerned with the various alternative solutions to a problem operating in the intended environment, then it appears that the analyst is missing a point. While the cost element of his analyses is concerned with the alternative solutions, the effectiveness element is concerned with both solution and the operational problem that stimulated the generation of the solution alternative. This must be so, if we intend to measure the effectiveness of the solution "in its intended environment," since the intended environment of combat materiel includes the very problem, or threat, that initiated the whole exercise. This consideration is always involved in the credibility of effectiveness quantifications for materiel destined for combat interaction.

Let's test this consideration. Here is a definition of cost effectiveness that appeared in a paper in the journal of the Operations Research Society of America:

> **"Cost effectiveness analysis is an analytical technique for evaluating the broad management and economic implications of alternative choices of action, with the objective of assisting in the identification of the preferred choice."**

Note the words "alternative choices of action" and "preferred choice." Choices of action are solutions to some problem stimulus. But what is the problem requiring solution? The problem is to counter a threat, and there are two kinds of threats—the threats associated with combat interaction and threats implicit in the support of combat forces that are intended for direct combat interaction. Materiel developed to counter those threats implicit in non-combat support operations tends to be susceptible to methodological treatment and effectiveness quantification. On the other hand, materiel intended as a solution to the threats of direct combat interaction presents a monumental challenge to the quantifying analyst, especially considering the man/machine involvements and the indeterminacy of the conflict environment.

The tendency to evade the issue of operational uncertainty is obvious in the literature. A publication with a chapter on the rudiments of model building contained the following statement, quoted out of context:

> **"The enemy's reaction and his shift in defense weapons and tactics as we change our offense vehicles may be quantifiable in principal, but a formidable problem in practice—one that is often passed over in silence. Mixed forces and time-phasing may be left out of the model because of the computational difficulties they introduce."** [1]

The temptation to "suppress" operational uncertainty is great. But suppression of the basic pivotal factor, that brought the proposed materiel under consideration in the first place, would appear to be specious logic that can result in academic findings, or an erroneous series of findings that could well destroy important incipient new weapons.

[1] *"Analysis for Military Decisions," E. S. Quade, p. 69.*

Let's turn now to Figure 8 which sets forth the relationship between the probability of credible quantifications and the maturity of materiel intended for operation in the differing environments just mentioned. For materiel intended to operate in a scenario of lower operational uncertainty, labeled on the chart "combat interaction—none," the rate of increase of credible quantifications with evolutional maturity is quite high. In other words, this category of materiel during engineering development can probably be measured for effectiveness with reasonably high credibility.

Examples of this category of materiel might be the C–5A heavy logistics aircraft and possibly the Fast Deployment Logistic Ship. This materiel is generally not intended to close with the enemy in combat and the uncertainty that he represents does not as a rule perturb the environment that is of concern in effectiveness measurement. On the other hand, materiel which is intended for close interaction with the threat in combat, depicted by the curve labeled "combat interaction—total" presents a high entropy challenge, poorly adapted to credible measurement because of the high degree of operational uncertainty. This is true throughout the developmental life cycle until use-disciplined employment doctrine is generated, either through field exercises or actual combat use. Examples of this type of materiel, generally tactical in nature,

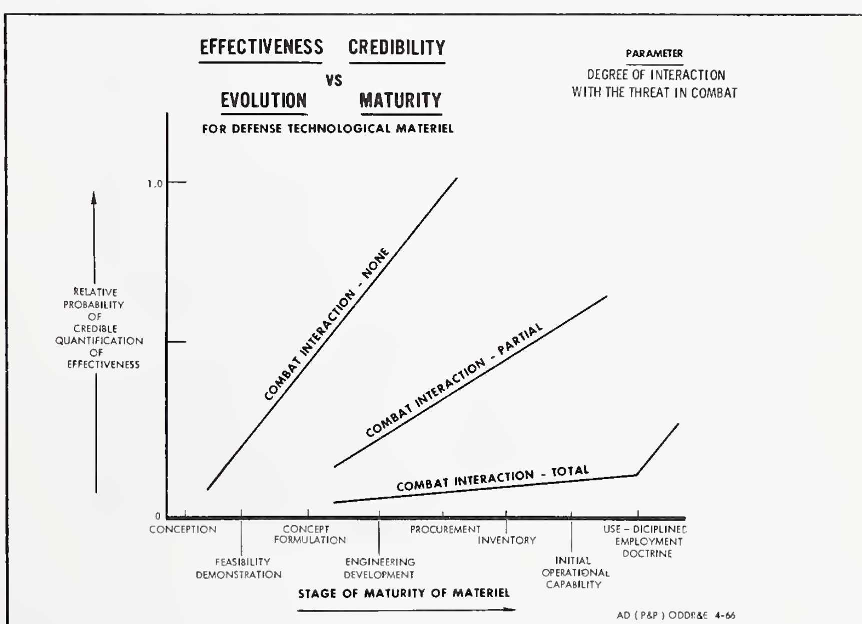


Figure 8.

might be the SAM–D or tactically configured V/STOL aircraft. The middle curve recognizes that the combat interaction spectrum is continuous and that materiel exists that will operate in varying mixes of these environment extremes. Certain offensive and defensive strategic materiel, for example, is developed to operate in this partial interaction environment.

It's important at this point to recognize that the accommodating characteristics of the man component of the man-machine relationship makes the system into which the analyst works a forgiving one. The combat soldier, airman, or sailor, because he has rational ingenuity and latent talent, will compensate for errors in judgment unwittingly made during the period that the operational characteristics of his materiel were being determined. He shoulders this compensation burden because options aren't available. Further, he shoulders it silently in many instances because he doesn't know what alternate operational capability he might have had. Here is a cost that is truly indeterminate and sublime in its immensity. The most cost-effective materiel, from the standpoint of the theoretical technologist or analyst, may in combat be imposing an intolerable cost or penalty upon the pilot, missileman, or combat soldier. The man-machine in combat is a forgiving system because the man has no alternative; his welfare depends in most cases on the machine. However, the cost in terms of reduced efficiency resulting from additional strain on the human organism, or from the need for greater proficiency, can be enormous. A most serious eventuality can result if the man's best efforts cannot close the operational gap between his materiel and the demands of his combat environment. Until the methodology of cost effectiveness has developed a method for coping with this form of cost, the cost-effectiveness technique applied to combat interacting materiel during the requirements definition phase must be recognized as incomplete and susceptible to potentially malignant error.

We have up to this point individually examined the three characteristics of materiel upon which is based the answer, "It depends," which was given in response to the question, "Can the effectiveness of R&D be measured?"

Figure 9 depicts orthogonally the matrix of the total mix of end-use oriented R&D materiel, considering these three characteristics. The x-axis sets forth the spectrum of combat interaction, the y-axis treats conceptual maturity and the z-axis developmental maturity. By viewing this matrix, it's possible to visualize the parametric interrelationships, to identify the R&D materiel which is most susceptible to credible effectiveness quantification (area A), and to identify that R&D materiel which might, as we stated at the beginning, well suffer from any measurement attempt (area B). Again this is qualitative and not intended to develop sharp zones of distinction but is shown to focus attention upon what might be considered the permissive and forbidden areas.

With respect to this materiel categorized as forbidden to the numbers-oriented analyst, we might reflect on a possible logic derivative of some well chosen words provided by Charles Hitch. He wrote:

> **"The human mind has some great advantages over any machine—if we think of them as rivals or alternatives. It has, by comparison, a capacious memory, which enables it to learn from experience. It has a remarkable facility for factoring out the important variables and suppressing the rest. These are the reasons human beings beat machines at chess or war games. But, on the side of analysis: First, it's wrong to look upon intuition and analysis or minds and machines as rivals or alternatives. Properly used, they complement each other. We have seen that every system analysis is shot through with intuition and judgment. Every decision that seems to be based on intuition is probably shot through with species of analysis."** [2]

This statement might provide one key to the optimization of the operational characteristics of combat interaction weaponry. If the human mind has great advantages over the machine, because it learns from experience and can factor out important variables, it would appear that one challenge then is to maintain the complementary relationship mentioned, and not permit the ascendency of the analytical machine over the mind. If decisions that seem to be based on intuition are indeed shot through with analysis, it might well follow that the superior quality of that underlying analysis derives from the advantage that the mind has in the first place, namely, capacious memory and ability to learn from experience and factor out important variables. It would seem imperative, therefore, to guard against straight-jacketing this superior analytical capability. Forced conformance of intuition and judgment to the unyielding demands of the machine could represent unwitting retrogression of the total analytical system. After all, if the judgment and intuition to which Mr. Hitch refers is the characteristic that enables the human mind to beat machines at war games, it may well be that that very judgment is the key to optimal characteristics of combat interaction materiel.

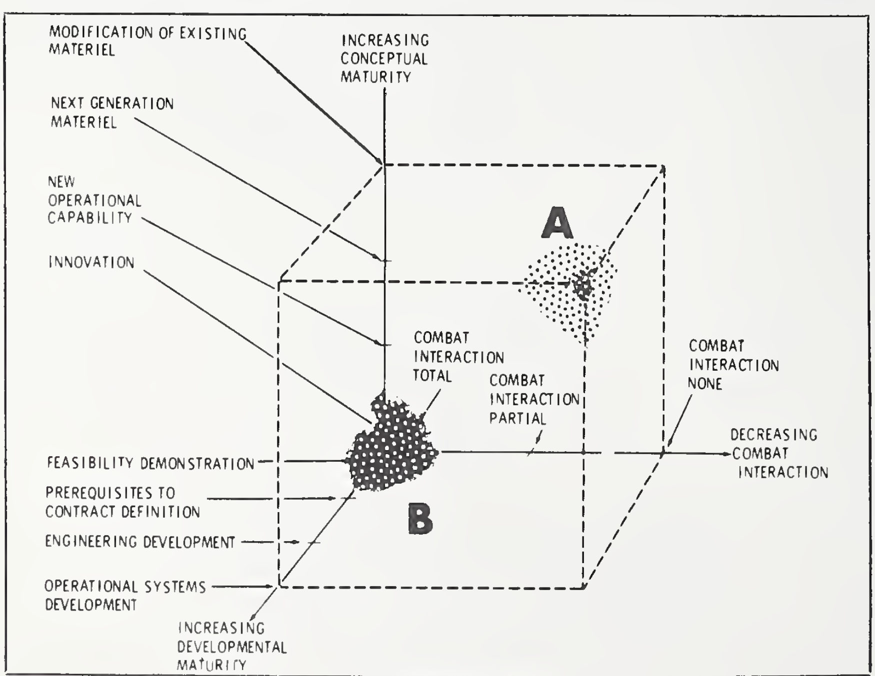


Figure 9.

[2] *"Analysis for Military Decision," E. S. Quade, p. 21.*

(*Continued on page* 21)

NOTES FOR EDITORS

Briefed below are some events and projects within the Department of Defense which may be of interest to writers and editors. If further information on any of these topics is desired, please write to Chief, Magazine and Book Branch, Office of Assistant Secretary of Defense (Public Affairs), Washington, D. C., 20301.

NEW NAVY CRAFT THAT FLOAT ON AIR NOW IN VIETNAM

Three Navy craft that "float" on a cushion of air are in operation in Vietnam. Each of the high-speed patrol boats is powered by a single gas turbine engine which provides both lift and propulsion through a lift fan and an aircraft-type variable pitch propeller. The 39-foot craft can travel over water, swamp and flat land areas at speeds in excess of 50 knots while combat loaded. Each boat is manned by two officers and two enlisted men. They are taking part in the Navy's coastal surveillance operations in Vietnam.

AIR FORCE TESTS FAST SETTING POLYESTER FOR HELO LANDING SITES

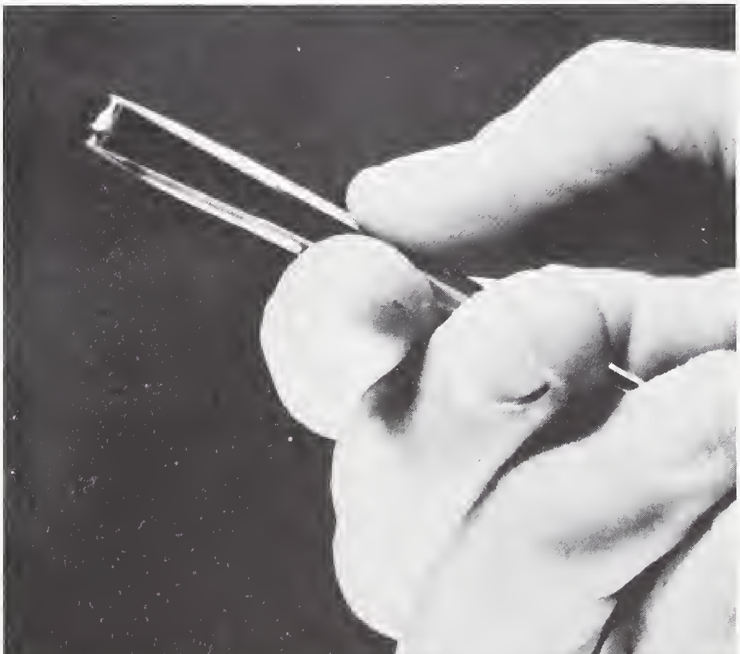
Rapid landing sites that can be ready to receive vertical/short takeoff and landing aircraft and helicopters in one and one-half hour are just around the corner. One of the materials under commercial development for the Air Force is a fast-setting polyester resin. In tests, a 16x32-foot shelter floor of the chlorinated polyester resin formulation reinforced with fiber glass was sprayed over soft, desert sand. Spraying was completed in 30 minutes and the floor, approximately one-fourth inch thick and weighing about two pounds per square foot, had hardened within one hour. The floor showed no damage or permanent deformation after it was tested successively with two automobiles weighing 3,600 pounds each, a 7,000-pound UH–1 helicopter with steel skids, a 9,000-pound fork lift, a 10,500-pound S–58 helicopter and a 17,500-pound fire truck. Additional tests will be conducted to measure shrinkage, cracking and fire resistance.

ADVANCED HYDROGEN GENERATOR UNDERGOES TESTS BY U.S. ARMY

The Army is currently testing an advanced hydrogen generator for use with hydrogen-air fuel cells. Weighing 460 pounds and occupying 18 cubic feet, the generator is expected to make possible, for the first time, a practical electric power system that combines very high efficiency and inexpensive liquid fuel. In operation, the generator uses slightly more than two quarts of fuel an hour to produce 140 cubic feet an hour of ultra-pure hydrogen, which can be used in practical fuel cells to produce 7,000 watts of DC electrical power. The generator itself requires only 325 watts. Five quarts of water an hour are consumed in the steam-reforming process of the generator. However, it can be supplied by water recovery from the fuel cell and the generator stack gas, thereby making the system practically self-sustaining.

ARMY DEVELOPS TINY YET RUGGED SIGNAL DEVICE

The Army has developed a radiowave signal generator the size of a grain of rice. The essential material in the generator, gallium arsenide, is a speck invisible to the naked eye. Experiments so far have proven the device highly efficient with almost unprecedented signal strength output in comparison to electrical power input. The generator has unusual frequency ranges in the microwave and millimeter portions of the spectrum; tests have been pushed up to 40 gigacycles (one billion cycles per second). As a solid-state device, the signal generator is inherently rugged, long-lived and, in mass production, would be cheap to produce. Additionally, it is highly compatible with the microelectronic circuitry now being produced for a growing number of other electronic functions.



So small it requires tweezers for handling, this radio-wave generator, or oscillator, promises to supplant devices up to hundreds of times larger in some of the Army's future models of lightweight communications and radar equipment. The solid state generator's essential material, a speck of gallium arsenide invisible to the naked eye, is contained within the package held by the tweezers.

The Development of SAIMS

by
Col. Herbert Waldman, USAF
Dir. for Assets Management Systems
Office of Asst. Secretary of Defense (Comptroller)

The objectives, overall structure and development principles of the Resource Management Systems were addressed by Assistant Secretary of Defense (Comptroller) Robert N. Anthony during the DOD-National Security Industrial Association Advanced Planning Briefings for Industry and published in the April 1966 issue of the *Defense Industry Bulletin.* The structure of that system was identified in four areas (Chart 1).

This article concentrates on further description of the effort to develop the Selected Acquisitions Information and Management System (SAIMS), which is one of the types identified therein and is concerned with:

> **The management of the acquisition, utilization and disposition of capital assets, which is the process of getting the weapon and support systems of the quality and configuration we need, on schedule, and at lowest cost.**

The Cost Information Reports (CIR) are one part of SAIMS, the Economic Information System (EIS) another. Initial efforts in both of these parts have been reviewed and approved by the Bureau of the Budget for implementation. The implementation of the new reports will result in phasing out existing reporting requirements as shown in Chart II.

Major systems design effort is also currently in process in the third part of SAIMS, which is concerned with performance measurement (Chart III). Work in the SAIMS area is currently being accomplished in the Directorate for Assets Management Systems under the Deputy Assistant Secretary of Defense (Management Systems Development) in the Office of the Assistant Secretary of Defense (Comptroller).

The objectives of SAIMS, which are common to all resource management systems intended for use by managers, are:

- To provide managers at all levels within DOD with information that will help them assure that resources are obtained and used effectively and efficiently in the accomplishment of DOD objectives.
- To provide information that is useful in the formulation of objectives and plans.
- To provide data to support program proposals and requests for funds.
- To provide a means of assuring compliance with statutes, agreements with Congressional committees and other requirements relating to resources emanating from outside DOD.

It is generally recognized that a large number of information and management subsystems are available today for such use with varying degrees of efficiency. What is sought now is a unification of approach to provide the data needed by Defense management without the disproportionate diversion of resources to support the many required information flows.

In improving current efforts, SAIMS will specifically provide:

- Performance measurement data comparing resource outlays and actual progress against planned time schedules, planned costs and planned technical performance goals.
- Funds data for measuring and controlling the need for and the flow of funds.
- Data on costs of selected weapon systems and their major, defined components.
- Data for the measurement of the economic impact of Defense procurement.

Results will be achieved through a "systems" approach in development. The specific work program will ensure that what is developed is necessary, feasible, useable and implemented according to plan.

In developing an improved management control system, which is the technical synonym for performance measurement, the effort is being oriented throughout the process of management systems development to serve project managers' needs.

Defense management will benefit from these efforts by having:

- A uniform, integrated system for obtaining reliable, timely and comparable schedule, cost and technical performance data compared to plans and specifications, to improve planning, programming, budgeting, contract negotiating and, particularly, systems/project management.
- A system which minimizes the impact upon the contractors' internal management and accounting systems and contract costs.
- A continuing source of essential information on which to base assessments of the economic impact of Defense contracts on employment, by

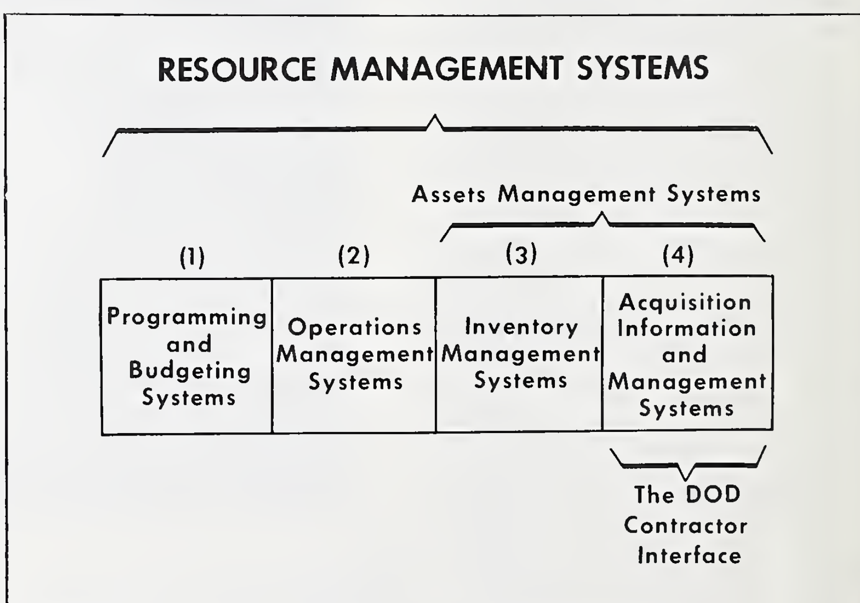


Chart I.

individual plans and local geographic area.

- A continuing evaluation of new approaches and innovations in the construction of management systems, with the goal of improving DOD management effectiveness and reducing management costs.

Current efforts are being devoted to an investigation of existing management systems procedures and data gathering systems concerned with cost, schedule and technical performance as a prelude to the design of data collection prototypes. The development of requirements for reporting funding information (Contract Funds Status Report—CFSR) is the remaining part of this current systems design effort.

Industry comments and recommendations for improving the initial approach in designing CFSR have been received, are being evaluated, and will result in a means of collecting data about estimates of change in contract funding requirements to support financial management. Positive collaboration with industry will continue so that responsible criticism becomes an explicit element of input in future management systems design.

PLANNED PHASEOUT OF DOD REPORTING REQUIREMENTS

Existing Reports Current	Proposed Replacement	Plants Affected	Effective Date
DD Form 1401 Plant Data	Format 1 Plantwide Economic Report	All	Upon BOB Approval
DD Form 1401-1 Direct Labor Data DD Form 1401-2 Completed Unit Data DD Form 1401-3 Flowtime and Release Dates DD Form 1177 Cost Incurred on Contract	Cost Information Reports	Producers of Elements of Aircraft Missile & Space Systems	a. New contracts-CIR, when established,will be used for Selected Acquisition, after OSD approval. b. Current contracts-DCPR Series continues through contract completion unless agreement is reached between Government and Industry representatives for replacement by CIR.
		All Other	a. New contracts-CIR, when established, may be used to the extent agreement is reached between Government and Industry representatives expressed in a contract. b. Current contracts-DCPR series continues through contract completion unless agreement is reached between Government and Industry representatives for replacement by CIR.

Chart II.

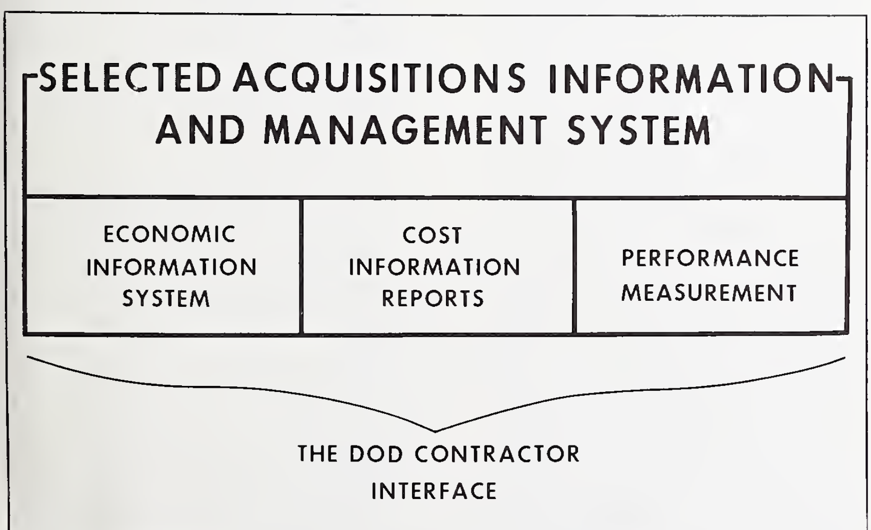


Chart III.

New Weather Radars Slated For S.E. Asia

Powerful new long-range weather radars, capable of giving advance knowledge of rainfall and other weather conditions 200 miles away and up to 15 miles high, are being procured by the Air Force for use in Southeast Asia.

Developed for the U.S. Weather Bureau by the Raytheon Co. specifically for weather detection and analysis, three of the radars will be installed by the Air Force at selected locations in Southeast Asia

The radars will be positioned in a triangle to provide maximum coverage of meteorological phenomena. The storm-detecting equipment will keep an electronic round-the-clock track of weather in a 200,000-square-mile area.

The 433L System Program Office at the Air Force Systems Command's Electronic Systems Division, L.G. Hanscom Field, Mass., is responsible for procuring and installing the high priority radars. Raytheon Co. is prime contractor for the system.

Problem Mongers, Solution Mongers

(*Continued from page* 18)

In closing it's worth noting that a growing number of statesmen in the scientific and technological community have been expressing concern over the dangers of technological complacency and the need for innovation encouragement. This discussion of problem mongers, solution mongers and operational uncertainty offers the following postulate for consideration, namely, one of the best ways to strangulate innovation is to attempt to rigorously quantify the effectiveness of innovative concepts.

Attempts to quantify the unquantifiable, in the interests of satisfying the demands of an unyielding methodology, is a potentially stifling practice that could cause irreparable damage to our technological supremacy and the consequent ability to defend ourselves during the challenging decades ahead. At the other extreme, neglect of the quantifiable economics of defense materiel, in the interests of cost-free choices of action, is also a dangerous practice that could cause irreparable damage to our economic solvency and the consequent fiscal stability necessary during the challenging decades ahead. The prudent course lies between those two extremes. Enlightened understanding, on the part of the military, technical and economic professional, of the limits and constraints of their regions of competency can contribute greatly toward assuring that this judicious course is maintained.

DEFENSE PROCUREMENT

Contracts of $1,000,000 and over awarded during the month of May 1966:

DEFENSE SUPPLY AGENCY

1—**Crowley Industrial Bag Co.**, Crowley, La. $1,406,400. 55,000 packages of osnaburg sandbags (100 bags to a package). Crowley. Defense General Supply Center, Richmond, Va.

—**Cavalier Bag Co.**, Lumberton, N.C. $1,-901,105. 10,000 packages of burlap sandbags and 70,000 packages of osnaburg sandbags (100 bags to a package). Lumberton. Defense General Supply Center, Richmond, Va.

—**Anderson Tank & Mfg. Co.**, Flint, Mich. $2,872,100. 7,000 metal shipping boxes. Flint. Defense General Supply Center, Richmond, Va.

—**Putnam Mills**, New York City. $1,097,250. 627,000 yards of cotton oxford cloth. New York City. Defense Personnel Support Center, Philadelphia.

—**Bates Fabrics**, New York City. $3,285,000. 2,000,000 yards of cotton oxford cloth. New York City. Defense Personnel Support Center, Philadelphia.

—**Prestex, Inc.**, New York City. $1,029,000. 600,000 yards of cotton oxford cloth. New York City. Defense Personnel Support Center, Philadelphia.

—**J. P. Stevens & Co.**, New York City. $4,-955,250. 1,075,000 yards of wool gabardine cloth. New York City. Defense Personnel Support Center, Philadelphia.

—**Bruce Products, Inc.**, Eatontown, N.J. $1,-974,469. 167,310 men's wet-weather parkas. Eatontown. Defense Personnel Support Center, Philadelphia.

2—**J. P. Stevens & Co.**, New York City. $3,-840,850. 3,000,000 yards of combed cotton twill cloth and 972,000 yards of carded cotton twill cloth. New York City. Defense Personnel Support Center, Philadelphia.

—**Cone Mills Corp.**, Greensboro, N.C. $1,130,-189. 1,784,524 yards of carded cotton twill cloth. Greensboro. Defense Personnel Support Center, Philadelphia.

6—**Centre Mfg. Co.**, Centre, Ala. $1,071,000. 100,000 men's lightweight raincoats. Centre. Defense Personnel Support Center, Philadelphia.

—**Bruce Products**, Eatontown, N.J. $1,369,-800. 110,000 men's lightweight raincoats. Eatontown. Defense Personnel Support Center, Philadelphia.

—**U. S. Bedding Co.**, St. Paul, Minn. $1,341,-825. 52,500 bunk beds. St. Paul. Defense General Supply Center, Richmond, Va.

—**Republic Steel Corp.**, Youngstown, Ohio. $8,895,200. 40,000 bundles of steel landing mats. Youngstown. Defense Construction Supply Center, Columbus, Ohio.

7—**Eastman Kodak Co.**, Rochester, N.Y. $1,-366,914. 9,300 rolls of aerial photographic film. Defense General Supply Center, Richmond, Va.

—**J. P. Stevens & Co., Inc.** New York City. $1,621,659. 1,875,000 yds. of water repellent cotton cloth. New York City. Defense Personnel Support Center, Philadelphia. **J. F. McElwaine Co.**, Nashua, N.H. $1,-544,000. 200,000 pairs of shoes. Nashua. Defense Personnel Support Center, Philadelphia.

—**Norrwock Shoe Co.**, Norridgewock, Maine. $2,008,109. Norridgewock. Defense Personnel Support Center, Philadelphia.

—**Genesco, Inc.**, Nashville, Tenn. $1,260,000. 150,000 pairs of shoes. Nashville. Defense Personnel Support Center, Philadelphia.

8—**Standard Oil Co.** (Kentucky), Louisville, Ky. $2,826,295. 16,738,000 gallons of motor gasoline and 4,885,600 gallons of distillates. Defense Fuel Supply Center, Alexandria, Va.

—**Gulf Oil Corp.**, Houston, Tex. $1,426,919. 3,700,000 gallons of motor gasoline, 7,000,-000 gallons of distillates, and 2,350,000 gallons of residual fuels. Defense Fuel Supply Center, Alexandria, Va.

—**Lockheed Aircraft Corp.**, Marietta, Ga. $1,453,680. 1,425 cargo trailers. Defense General Supply Center, Richmond, Va.

9—**Standard Oil Co. of Calif.**, San Francisco. $1,810,686. 12,691,260 gallons of RF–1 rocket fuel. Defense Fuel Supply Center, Alexandria, Va.

10—**Deering Milliken, Inc.**, New York City. $2,-677,530. 599,000 yds of wool gabardine cloth. Defense Personnel Support Center, Philadelphia.

—**Interstate Mfg. Co. Inc.**, Hudson, Mass. $1,089,280. 92,000 pairs of men's wet-weather, coated nylon overalls. Defense Personnel Support Center, Philadelphia.

—**Payne & Associates, Inc.**, Raleigh, N.C. $1,216,369. 100,108 pairs of men's wet-weather coated nylon overalls. Defense Personnel Support Center, Philadelphia.

—**Superior Sleeprite Corp.**, Chicago. $1,201,-830. 48,500 steel bunk beds. Defense General Supply Center, Richmond, Va.

13—**Shell Oil Co.**, New York City. $1,644,461. Petroleum services & products. Defense Fuel Supply Center, Alexandria, Va.

14—**Continental Motors Corp.**, Muskegon, Mich. $1,017,159. 3,985 cylinder assemblies. Defense Construction Supply Center, Columbus, Ohio.

—**LaCrosse Garment Mfg. Co.**, La Crosse, Wis. $1,150,062. 425,949 nylon insect bars. Defense Personnel Support Center, Philadelphia.

—**Boothe Packing Co.**, Modesto, Calif. $3,-381,811. 4,400,008 cases of individual combat meals. Defense Personnel Support Center, Philadelphia.

—**Usibelli Coal Mine, Inc.**, Fairbanks, Alaska. $1,227,022. 208,500 tons of sub-bituminous coal. Defense Fuel Supply Center, Alexandria, Va.

—**Vitro Minerals Corp.**, New York City. $1,-219,725. 208,500 tons of sub-bituminous coal. Defense Fuel Supply Center, Alexandria, Va.

15—**Dow Chemical Co.**, Midland, Mich. $1,943,-280. 256,000 gallons of herbicide. Defense General Supply Center, Richmond, Va.

—**Putnam Mills**, New York City. $1,985,540. 2,059,496 yds of cotton duck cloth. Defense Personnel Support Center, Philadelphia.

—**Kayser Roth Corp.**, Woodbury, Tenn. $1,-017,216. 198,480 men's pajama trousers & 135,600 men's pajama coats, both of cotton flannel. Defense Personnel Support Center, Philadelphia.

—**Standard Oil Co., of Calif.** San Francisco. $2,285,769. 639,600 gallons of gasoline; 84,000 gallons of diesel fuel; 10,836,291 gallons of fuel oil; & 16,105 gallons of solvent. Defense Fuel Supply Center, Alexandria, Va.

—**Evan Jones Coal Co.**, San Francisco. $2,-529,450. 251,000 tons of bituminous coal. Defense Fuel Supply Center, Alexandria, Va.

16—**Sinclair Refining Co.**, New York City. $1,-858,500. 12,600,000 gallons of grade 115/145 aviation gasoline. Defense Fuel Supply Center, Alexandria, Va.

—**Phillips Petroleum Co.**, Bartlesville, Okla. $1,585,332. 11,340,000 gallons of grade 115/145 aviation gasoline. Defense Fuel Supply Center, Alexandria, Va.

—**Cities Service Oil Co.**, New York City. $1,-251,776. 8,400,000 gallons of grade 115/145 aviation gasoline. Defense Fuel Supply Center. Alexandria, Va.

—**Page Airways, Inc.**, $1,060,000. Operation & maintenance of the Defense Industrial Plant Equipment Facility at Atchison, Kan. Defense Industrial Plant Equipment Center, Memphis, Tenn.

17—**Southern Athletic Co.**, Knoxville, Tenn. $3,-396,585. 556,380 coated nylon twill ponchos. Defense Personnel Support Center, Philadelphia.

20—**Charles Pfizer and Co.**, New York City. $1,632,121. 380,448 bottles of oxyetetracycline tablets. Defense Personnel Support Center, Philadelphia.

—**West Point Pepperell Inc.**, New York City. (1) $1,143,093. 815,765 yds of mildew-resistant, water-repellent cotton duck cloth. (2) $1,894,816. 1,450,909 linear yds of vat dyed, mildew-resistant, water-repellent cotton duck cloth. Defense Personnel Support Center, Philadelphia.

21—**Pascoe Steel Corp.**, Pomona, Calif. $1,011,-949. 213 Steel prefabricated bldgs. Defense Construction Supply Center, Columbus, Ohio.

—**Oscar Mayer & Co.**, Madison, Wis. $1,220,-518. 527,416 twenty-two ounce cans of pre-fried sliced bacon. Defense Personnel Support Center, Philadelphia.

—**Baird & McGuire, Inc.**, Holbrook, Mass. $1,153,399. 4,315 drums (55-gallons) of malathion insecticide. Defense General Supply Center, Richmond, Va.

—**J. M. Wood Mfg. Co., Inc.**, Waco, Tex. $3,141,500. 1,525,000 pairs of men's cotton sateen trousers. Defense Personnel Support Center, Philadelphia.

—**Twinco Products Inc.**, San Fernando, Calif. $1,868,400. 1,080,000 pairs of men's cotton sateen trousers. Defense Personnel Support Center, Philadelphia.

—**Winfield Mfg. Co. Inc.**, Winfield, Ala. $1,-344,000. 800,000 pairs of men's cotton sateen trousers. Defense Personnel Support Center, Philadelphia.

22—**Gentex Corp.**, Carbondale, Pa. $1,914,583. 22,998 flying helmets. Defense Personnel Support Center, Philadelphia.

—**Putnam Mills**, New York City. $1,847,580. 742,000 yds of ballistic nylon cloth. Defense Personnel Support Center, Philadelphia.

—**Calloway Mills**, La Grange, Ga. $1,745,-100. 840,000 yds of ballistic nylon cloth. Defense Presonnel Support Center, Philadelphia.

23—**Valley Metallurgical Processing Co.**, Essex, Conn. $3,412,304. 4,399,000 lbs of magnesium powder. Defense General Supply Center, Richmond, Va.

—**Randolph Mfg. Co., Inc.**, Randolph, Mass. $2,927,924. 225,572 pairs of tropical combat boots. Defense Personnel Support Center, Philadelphia.

—**Hi-Pals Footwear Inc.**, Waynesville, N. C. $1,744,500. 150,000 pairs of tropical combat boots. Defense Personnel Support Center, Philadelphia.

—**Bata Shoe Co., Inc.**, Belcamp, Md. $4,942,-800. 360,000 pairs of tropical combat boots. Defense Personnel Support Center, Philadelphia.

—**Safety First Shoe Co.**, Nashville, Tenn. $5,027,904. 448,500 pairs of tropical combat boots. Defense Personnel Support Center, Philadelphia.

—**Endicott Johnson Corp.**, Endicott, N. Y. $1,888,320. 168,000 pairs of tropical combat boots. Defense Personnel Support Center, Philadelphia.

—**Wellco Shoe Div. of Wellco Ro-Search Industries, Inc.**, Waynesville, N.C. $1,158,430. 91,000 pairs of tropical combat boots. Defense Personnel Support Center, Philadelphia.

—**Guilford Mills**, Greensboro, N.C. $2,806,625. 10,549,000 yds of knitted nylon cloth. Greensboro. Defense Personnel Support Center, Philadelphia.

—**Gilbraltar Fabrics, Inc.**, Brooklyn, N.Y. $1,062,035. 4,000,000 yds of knitted nylon cloth. Defense Personnel Support Center, Philadelphia.

24—**Ansul Co.**, Marinette, Wis. $2,084,800. 400,000 gallons of herbicide. Defense General Supply Center, Richmond, Va.

—**Cross Country Clothes, Inc.**, Northampton, Pa. $1,061,178. 41,115 men's tropical wool coats. Defense Personnel Support Center, Philadelphia.

—**Humble Oil & Refining Co.**, Houston, Tex. $3,443,370. 35,490,000 gallons of JP–4 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

—**Texaco Inc.**, New York City. $3,002,832. 30,240,000 gallons of grade JP–4 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

—**Coastal States Petrochemical Co.**, Houston, Tex. $2,619,749. 28,371,000 gallons of grade JP–4 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

—**Continental Oil Co.**, Houston, Tex. $1,238,-706. 12,600,000 gallons of grade JP–4 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

27—**Centre Mfg. Co.**, Centre, Ala. $1,121,655. 106,520 men's nylon-coated raincoats. Defense Personnel Support Center, Philadelphia.

—**Sprapak Chemicals, Inc.**, Brooklyn, N.Y. $1,470,300. 2,500,000 cans of insecticide. Defense General Supply Center, Richmond, Va.

28—**Winthrop Laboratories**, New York City. $1,602,609. Quantities of primaquine and chloroquine products. Defense Personnel Support Center, Philadelphia.

—**Abate Clothing, Inc.**, Atlantic City, N.J. $1,213,800. 60,000 men's wool serge coats. Defense Personnel Support Center, Philadelphia.

—**B. G. Colton Textiles**, New York City. $3,497,000. 2,000,000 yds of wind resistant cotton & nylon sateen cloth. Defense Personnel Support Center, Philadelphia.

—**Erwin Mills**, New York City. $1,626,100. 1,125,000 yds of wind resistant cotton and nylon sateen cloth. Defense Personnel Support Center, Philadelphia.

—**Eastman Kodak Co.**, Rochester, N.Y. $1,008,440. 13,600 rolls of aerial duplicating film. Defense General Supply Center, Richmond, Va.

29—**Weathervane Outerwear Corp.**, New York City. $3,853,577. 422,670 camouflage poncho liners. Defense Personnel Support Center, Philadelphia.

—**Hunter Outdoor Products, Inc.**, Long Island, N.Y. $1,439,019. 659,780 duffel bags. Defense Personnel Support Center, Philadelphia.

—The Defense Personnel Support Center, Philadelphia, has awarded the following contracts for body armor **vests**.

L. W. Foster Sportswear Co., Philadelphia. $1,327,995. 76,000 vests.

Kings Point Industries, New York City. $1,812,000. 100,000 vests.

Martin Lane Co., Elizabeth, N.J. $1,367,098. 77,150 vests.

—**Morris Bros., Inc.**, New York City. $1,641,915. 900,000 white cotton bed sheets. Defense Personnel Support Center, Philadelphia.

—**Springs Cotton Mills**, New York City. $1,454,880. 860,000 white cotton bed sheets. Defense Personnel Support Center, Philadelphia.

—**B. G. Colton Textiles**, New York City. $1,478,922. 1,123,250 yds of wind resistant cotton oxford cloth. Defense Personnel Support Center, Philadelphia.

—**C. M. London Co.**, New York City. $1,080,104. 820,000 yds of wind resistant cotton oxford cloth. Defense Personnel Support Center, Philadelphia.

—**Cone Mills Corp.**, Greensboro, N.C. $1,091,481. 1,306,888 yds of cotton polyester twill cloth. Defense Personnel Support Center, Philadelphia.

—**Texaco Inc.**, New York City. $2,032,128. 20,160,000 gallons of grade JP–4 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

—**Gulf Oil Corp.**, New York City. $3,124,380. 33,600,000 gallons of grade JP–5 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

30—**Albert Turner & Co.** New York City. $1,086,813. 40,950 men's green wool serge coats with belts. Defense Personnel Support Center, Philadelphia.

—**Phillips Petroleum Co.**, Bartlesville, Okla. $1,022,950. 10,250,000 gallons of grade JP–4 jet fuel. Defense Fuel Supply Center, Alexandria, Va.

—**Stauffer Chemical Co.**, New York City. $1,731,015. 428,461 gallons of aircraft turbine engine lubricating oil. Defense Fuel Supply Center, Alexandria, Va.

ARMY

1—**I.B.M.**, White Plains, N.Y. $3,500,000. Classified electronics equipment. Poughkeepsie, N.Y. Army Electronics Command, Fort Monmouth, N.J.

—**List & Clark Construction Co.**, Overland Park, Kan. $2,357,168. Work on the Missouri River agricultural levees. Near St. Joseph, Mo. Engineer Dist., Kansas City, Mo.

2—**Firestone Tire & Rubber Co.**, Akron, Ohio. $2,834,595. Rubber track shoe assemblies for the M60 combat vehicle. Noblesville, Ind. Army Tank Automotive Center, Warren, Mich.

—**Southern Airways of Texas**, Mineral Wells, Tex. $14,404,255. Training of Army helicopter pilots and maintenance of aircraft at Fort Wolters, Tex. Purchasing and Contracting Office, Fort Wolters, Tex.

—**List & Clark Construction Co.**, Overland Park, Kan. $2,451,947. Construction work on the Stockton, Missouri, Project. Stockton. Engineer Dist., Kansas City, Mo.

3—**Bell Helicopter Co.**, Fort Worth, Tex. $9,718,199. UH–1 transmission assemblies. $1,142,676. UH–1 main rotor blade assemblies. Fort Worth. Army Aviation Materiel Command, St. Louis.

—**Continental Aviation & Engineering Corp.**, Detroit. $2,065,411. Production and inspection engineering services for 2½-ton and 5-ton truck engines. Detroit. General Purpose Vehicle Project Manager, Army Mobility Command, Warren, Mich.

—**Philco Corp.**, Philadelphia. $4,000,000. Classified electronic equipment. Philadelphia. Army Electronics Command, Fort Monmouth, N.J.

—**Laboratory for Electronics, Inc.**, Boston, Mass. $8,714,261. Aircraft position-fixing navigation sets. Danvers, Mass. Army Electronics Command, Philadelphia.

—**Matich Bros.**, Colton, Calif. $1,586,290. Strengthening of airfield pavements at Norton AFB, Calif. Engineer Dist., Los Angeles.

6—**Farrell Construction Co.**, Memphis, Tenn. $1,972,868. Work on the West Point Reservoir, Alabama, Project. West Point, Ga. Engineer Dist., Savannah, Ga.

—**Eastern Canvas Products, Inc.**, Haverhill, Mass. $4,896,536. Protective hoods. Haverhill. Edgewood Arsenal, Md.

—**Kaiser Jeep Corp.**, Toledo, Ohio, $3,227,538. M–39 trucks with Government furnished, multi-fuel engines. Toledo. General Purpurpose Vehicle Project Manager, Army Mobility Center, Warren, Mich.

—**Hallmark Industries**. Patterson, Calif., $4,572,960. Fabrication of 3,000 lightweight aluminum hut kits. Patterson. ACS–G4, U.S. Army, Hawaii.

7—**Douglas & Lomason Co.**, Columbus, Ga. $1,291,283. Columbus. Ordnance items. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Philco Corp.**, Newport Beach, Calif. $1,496,905. Shillelagh spare parts. Newport Beach. Southwest Procurement Agency, Pasadena, Calif.

8—**Collins Radio Co.**, Dallas, Tex. $2,250,000. High-frequency, single side-band, airborne radio sets. Dallas. Army Electronics Command, Fort Monmouth, N.J.

—**Olin Mathieson Chemical Corp.**, New Haven Conn. $1,467,600. Shoulder stocks for M14 rifles. Springfield Armory, Springfield, Mass.

—**Brunswick Corp.**, Marion, Va. $1,637,319. 35mm cartridge launchers. Parkersburg, Pa. and Marion. Edgewood Arsenal, Md.

—**F. D. Rich Co., Inc.** Stamford, Conn. $3,306,063. Expansion of water supply, electrical distribution and telephone systems at the U.S. Military Academy, West Point, N.Y. Engineer Dist., New York N.Y.

—**Troup Brothers, Inc.**, Coral Gables, Fla. $2,837,953. Work on Canal 54 of the Central and Southern Florida Flood Control Project. Melbourne, Fla. Engineer Dist., Jacksonville, Fla.

9—**Maremont Corp.**, Saco, Maine. $1,471,922. M69 machine guns with barrel and bipod assemblies. Army Weapons Command, Rock Island Arsenal, Rock Island, Ill.

—**International Harvester Co.**, Melrose Park, Ill. $3,141,150. 79 full-tracked tractors for the Navy. Army Mobility Equipment Center, St. Louis.

—**Pace Corp.**, Memphis, Tenn. $1,627,732. 105mm canisters. Edgewood Arsenal, Md.

—**Universal Terminal & Stevedoring Corp.**, New York City. $13,898,953. Stevedoring services at the Military Ocean Terminal, Bayonne, N.J. Military Traffic Management and Terminal Services, Brooklyn, N.Y.

10—**U.S. Rubber Co.**, Mishawaka, Ind. $1,818,520. Body armor. Army Natick Laboratories, Natick, Mass.

—**Norton Co.**, Worcester, Mass. $1,207,680. Body armor. Army Natick Laboratories, Natick, Mass.

—**Chemical Compounding Corp.**, Jersey City, N.J. $1,144,093. Decontaminating & reimpregnating kits. Edgewood Arsenal, Md.

—**Scoville Mfg. Co.**, Waterbury, Conn. $1,072,811. Modification to an existing contract for bomb components. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**AVCO Corp.**, Stratford, Conn. $2,664,081. Modification kits in support of the T53 engine for UH–1 aircraft. Army Aviation Materiel Command, St. Louis.

—**Fullerton Construction Co.**, Sacramento, Calif. $1,175,000. Construction of an academic bldg. complex at the Defense Language Institute, Presidio of Monterey, Calif. Engineer Dist. Sacramento, Calif.

—**Dravo Corp.**, Pittsburgh, Pa. $3,616,730. Manufacture & delivery of tainter gates with hoists & other appurtenances, for locks & dams on the Arkansas River Navigation Project. Engineer Dist., Little Rock, Ark.

—**Missouri River Constructors, Inc.**, Dallas, Tex. $1,267,926. Work on the Mississippi River & Tributaries (Flood Control) Project. Chicot County, Ark. Engineer Dist., Vicksburg, Miss.

—**Martin K. Eby Construction Co.**, Wichita, Kan. $2,809,370. De Gray Dam & Reservoir, Caddo River, Arkansas Project. Clark County Ark. Engineer Dist., Vicksburg, Miss.

—**AVCO Corp.**, Stratford, Conn. $1,756,440. T53–L–15 aircraft engines & special tooling. Army Aviation Materiel Command, St. Louis.

13—**Construction Machinery Co.**, Waterloo, Iowa. $1,129,700. 286 concrete mixers. Army Mobility Equipment Center, St. Louis.

—**Federal Cartridge Corp.**, Minneapolis, Minn. $6,833,031. 5.56mm ammunition, and for operation and maintenance activities at the Twin Cities Army Ammunitiin Plant, New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Sperry Rand Corp.**, Salt Lake City, Utah. $1,131,138. Supplies & services to modify Sergeant missile components. Northwest Procurement Agency, Oakland, Calif.

14—**Stewart & Stevenson Services, Inc.**, Houston, Tex. $2,787,396. 400-cycle AC genertor sets. Army Mobility Equipment Center, St. Louis.

—**General Motors**, Cleveland, Ohio. $8,427,943. 155mm medium, self-propelled howitzer vehicles (M109). Cleveland. Army Weapons Command, Rock Island, Ill.

—**Ward La France Truck Corp.**, Elmira Heights, N.Y. $1,289,199. 149 firefighting Trucks. Army Mobility Equipment Center, St. Louis.

—**R.C.A.**, Burlington, Mass. $6,011,000. Research and development effort, data research, design, documentation, fabrication & test of the land Combat Support Systems (Sbillelagh, Lance & Tow missile systems). Army Missile Command, Huntsville, Ala.

15—**Northrop-Carolina, Inc.**, Ashville, N.C. $1,750,375. Chemicals. Swannanoa, N.C. Edgewood Arsenal, Md.

—**American Hoist & Derrick Co.**, St. Paul, Minn. $7,054,985. 262 rough terrain, air transportable wheel-mounted cranes. Fort Wayne, Ind. Army Mobility Equipment Center, St. Louis.

—**Bethlehem Steel Corp.**, Bethlehem, Pa. $1,500,000. Forging tubes for 175mm guns (M113). Watervliet Arsenal, N.Y.

—**General Steel Tank Co.**, Reidsville, N. C. $1,562,654. 80 portable fuel systems. Army Mobility Equipment Center, St. Louis.

—**Raytheon Co.**, Lexington, Mass. $4,500,966. Research & development work on the improved Hawk missile system. Bedford, Mass. Army Missile Command, Huntsville, Ala.

—**General Electric**, Burlington, Vt. $2,148,014. 7.62mm aircraft machine guns and armament pods (GAU2B/A and XM18). Army Weapons Command, Rock Island Arsenal, Rock Island, Ill.

—**TKU Construction Inc.**, Honolulu, Hawaii. $3,501,485. Construction of general purpose and humidity controlled warehouses; and for relocation of existing buildings at Machinato Service Area, Okinawa. Engineer Dist., Okinawa.

—**Hughes Aircraft**, Fullerton, Calif. $2,997,532. Two satellite communication terminals. (AN/MSC–46). Fullerton. Army Electronics Command, Fort Monmouth, N.J.

16—**Mine Safety Appliances Co.**, Pittsburgh, Pa. $2,474,522. Filter elements for protective field masks. Esmond, R.I. Edgewood Arsenal, Md.

—**General Electric**, Syracuse, N.Y. $1,111,581. Modification of two radar sets (AN/MPQ/–4A). Syracuse. Army Electronics Command, Fort Monmouth, N.J.

—**LTV Corp.**, Warren, Mich. $1,205,000. Long lead time facilities for the Lance missile system. Michigan Army Missile Plant, Sterling, Mich. Army Mobility Equipment Center, Warren, Mich.

—**Bernard McNenamy Contractor, Inc.**, St. Charles, Mo. $1,577,690. Kaskaskia River Navigation Project, Ill. Between Baldwin & New Athens, Ill. Engineer Dist., St. Louis.

—**Norris Thermador Corp.**, Los Angeles. $1,355,127. 81mm projectiles. Southwest Procurement Agency, Pasadena, Calif.

—**Litton Systems Inc.**, Van Nuys, Calif. $2,150,134. Scientific and technical effort in support of FY 67 combat development

experimentation. Fort Ord, Calif. Northwest Procurement Agency, Oakland, Calif.

17—**Vinnell Corp.**, Alhambra, Calif. (1) A $2,728,708. Modification to a contract for design, procurement, and construction of five electrical land distribution systems. Los Angeles. (40%) and remainder in South Vietnam. (2) A $3,025,000. Refitting of five T-2 tankers as power ships for South Vietnam. Army Mobility Equipment Center, St. Louis.

—**Standard Container, Inc.**, Montclair, N.J. $1,357,987. Ammunition boxes (M2A1). Homerville, Ga. Frankford Arsenal, Philadephia.

—**Olin Mathicson Chemical Corp.**, East Alton, Ill. $1,196,587. 5.56mm cartridges. Frankford Arsenal, Philadelphia.

—**Olin Mathieson Chemical Corp.**, New Haven Conn. $7,990,227. 7.62mm cartridges. Frankford Arsenal, Philadelphia.

—**Colts Inc.**, Hartford, Conn. $29,035,408. XM-16E1 rifles. Army Weapons Command, Rock Island Arsenal, Rock Island, Ill.

—**Schiller-Pfeiffer Machine Works, Inc.** Southampton, Pa. $3,418,700. 152mm high explosive, anti-tank projectile assemblies. Picatinny Arsenal, Dover, N.J.

—**Honeywell Inc.**, Hopkins, Minn. $2,781,392. 40mm cartridge fuzes. New Brighton, Minn. Ammunition Procurement and Supply Agency, Joliet, Ill.

—**Chrysler Corp.**, Warren, Mich. $19,647,460. 789 rough terrain, fork lift trucks. Warren. Army Mobility Equipment Center, St. Louis.

20—**Remington Arms Co., Inc.**, Bridgeport, Conn. $22,214,882. Small arms ammunition. Lake City Army Ammunition Plant, Independence, Mo. Ammunition Procurement & Supply Agency, Joliet, Ill.

21—**Whirlpool Corp.**, Evansville, Ind. $2,159,468. Metal parts for 105-mm projectiles. Evansville. Picatinny Arsenal, Dover, N.J.

—**Olin Mathieson Chemical Corp.**, New York City. $13,798,382. Propellant charges for artillery ammunition, and for operation and maintenance activities at the Army Ammunition Plant, Charlestown, Ind. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Consolidated Diesel Electric Co.**, Stamford, Conn. $1,649,830. 10-ton tractor trucks. Schenectady, N.Y. Army Tank Automotive Center, Warren, Mich.

—**Boeing Co.**, Morton, Pa. $8,000,000. CH-47 helicopter product improvement program. Morton. Army Aviation Materiel Command, St. Louis.

—**Bulova Watch Co.**, Flushing, N.Y. $1,113,961. Development of the XM552, 30mm high explosive dual purpose cartridge. Flushing. Picatinny Arsenal, Dover, N.J.

—**LeTourneau-Westinghouse Co.**, Peoria, Ill. $3,671,972. 250 motorized road graders. Indianoplis, Ind. Army Mobility Equipment Center, St. Louis.

—**Olin Mathieson Chemical Corp.**, New Haven, Conn. $2,248,000. Loading, assembling, packing 20mm cartridges. La Porte, Ind. Frankford Arsenal, Philadelphia.

—**Hawthorne Aviation**, Fort Sill, Okla. $1,810,027. Aircraft maintenance & related services in support of the U.S. Army Aviation Test Board. Cairns Army Airfield, Fort Rucker, Ala. Aberdeen Proving Grounds, Md.

—**Iowa Mfg. Co.**, Cedar Rapids, Iowa. $1,388,754. 13 semi-trailer mounted crushing & screening plants. Cedar Rapids. Army Mobility Equipment Center, St. Louis.

—**Northrop Corp.**, Anaheim, Calif. $1,049,984. 106mm projectiles. Anaheim. Picatinny Arsenal, Dover, N.J.

—**Bell Helicopter Co.**, Fort Worth, Tex. $2,927,394. TH-13T helicopters (basic instrument trainers). Fort Worth. Army Aviation Command, St. Louis.

22—**Cabot Corp.**, Pampa, Tex. $1,226,293. Tube forgings for the 105mm (M68). Kingsmill, Tex. Watervliet Arsenal, N.Y.

—**Wahiawa Builders, Inc.**, Wahiawa, Oahu, Hawaii. $1,024,050. Photo laboratory at Hickham AFB, Hawaii. Engineer Dist., Honolulu, Hawaii.

—**Kaiser Jeep Corp.**, Toledo, Ohio. $1,138,830. 3,451 engine assemblies for ¼-ton trucks. Toledo. Army Tank Automotive Center, Warren, Mich.

—**Kaiser Jeep Corp.**, Toledo, Ohio. $25,609,870. 1¼-ton trucks. Toledo. General Purpose Vehicle Manager, Army Mobility Equipment Center, Warren, Mich.

—**Colt's Inc.**, Hartford, Conn. $1,835,804. XM16E1 and M16 rifles. Hartford. Army Weapons Command, Rock Island Arsenal, Rock Island, Ill.

—**Hughes Aircraft**, Fullerton, Calif. $2,232,348. Man-packed radio sets (AN/PRC-74). Fullerton. Southwest Procurement Agency, Pasadena, Calif.

—**Bell Helicopter Co.**, Fort Worth, Tex. $1,600,550. Airframe structural components for UH-1 helicopter modification kits. Fort Worth. Army Aviation Materiel Command, St. Louis.

—**FMC Corp.**, San Jose, Calif. $1,028,535. Metal parts for 90mm projectiles (XM594). San Jose. Picatinny Arsenal, Dover, N.J.

—**Whirlpool Corp.**, Evansville, Ind. $2,004,372. 90mm canister assemblies (XM593). Evansville. Picatinny Arsenal, Dover, N.J.

—**Northrop Corp.**, Anaheim, Calif. $2,056,358. 90mm canister assemblies (XM593). Anaheim. Picatinny Arsenal, Dover, N.J.

23—**URS Corp.**, Burlingame, Calif. $2,133,534. Technical reports, computer programs, & test plans for automation of selected logistics, personnel and administrative functions for the combat service support system. Fort Huachuca, Ariz. Army Electronics Proving Ground, Fort Huachuca.

—**General Dynamics**, Pomona, Calif. (1) $1,529,200. Engineering services for the rocket motor for Redeye; (2) $1,107,311. Test sets for Redeye. Pomona. Southwest Procurement Agency, Pasadena, Calif.

—**Stelma, Inc.**, Stamford, Conn. $2,790,045. Telephone-telegraph terminals (AN/TCC-29). Stamford. Army Electronics Command, Philadelphia.

—**Pacific Ventures, Inc. & West Coast Electric of Washington**, Seattle, Wash. $1,400,000. Upgrading improving Defense Communications power plants in Alaska. Engineer Dist., Anchorage, Alaska.

—**Dravo Inc.**, Pittsburgh, Pa. $24,377,294. Newbergh Lock & Dam, Ohio River Project. Evansville, Ind. Engineer Dist. Louisville, Ky.

—**General Motors**, Detroit. $1,856,368. Engines for M113 vehicles (6V53). Detroit. Army Tank Automotive Center, Warren, Mich.

—**General Electric**, Burlington, Vt. $1,780,011. 7.62mm aircraft machine guns & ancillary equipment. Army Weapons Command, Rock Island Arsenal, Ill.

—**Northrop-Carolina, Inc.**, Asheville, N.C. $1,094,792. 105mm canisters & smoke rounds. Asheville. Edgewood Arsenal, Md.

24—**Chrysler Motors**, Detroit. $4,502,279. 1,411 one-ton cargo trucks and 75 one-ton ambulances. Warren, Mich. Project Manager, General Purpose Vehicles, Army Mobility Command, Warren, Mich.

—**Sperry Rand Corp.**, New York City. $10,644,728. 2.75 inch rocket warheads and fuzes. Army Ammunition Plant, Shreveport, La. Ammunition Procurement and Supply Agency, Joliet, Ill.

—**Mason & Hanger, Silas Mason Co. Inc.**, Lexington, Ky. $4,546,100. 500 and 750 lb bombs. Cornhusker Army Ammunition Plant, Grand Island, Neb. Ammunition Procurement and Supply Agency, Joliet, Ill.

—**Hercules Inc.**, Wilmington, Del. $8,225,700. Propellants. Sunflower Army Ammunition Plant, Lawrence, Kan. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Wilcox Electric Co., Inc.**, Kansas City, Mo. $2,350,203. Transponder sets (AN/APX-44). Falls Church, Va. and Kansas City. Army Electronics Command, Fort Monmouth, N.J.

—**Northrop Corp.**, Newbury Park, Calif. $1,391,000. Target missile and tracking exercise flights. Newbury Park (20%) and 80% at various overseas locations. Army Missile Command, Huntsville, Ala.

—**R.C.A.**, Van Nuys, Calif. $3,500,00. Classified electronic equipment. Van Nuys. Army Electronics Command, Fort Monmouth, N.J.

—**Meador Contracting Co.**, Mobile, Ala. $1,195,200. Work on Miller Ferry Lock and Dam, Alabama, Project. Camden, Ala. Engineer Dist. Mobile, Ala.

—**Kanarr Corp.**, Kingston, Pa. $1,322,770. M79 grenade launchers. Kingston. Army Weapons Command, Rock Island, Ill.

—**TRW, Inc.**, Cleveland, Ohio. $1,486,860. M79 grenade launchers. Cleveland. Army Weapons Command, Rock Island, Ill.

—**ARF Products, Inc.**, Raton, N.M. $3,164,734. Ground Radio Set Group (OA-1387) components. Raton. Army Electronics Command, Philadelphia.

—**General Dynamics**, Rochester, N.Y. $3,559,566. Digital Subscriber Terminal Equipment (AUTODIN). Rochester. Army Electronics Command, Fort Monmouth, N.J.

—**Jackes-Evans Mfg. Co.**, St. Louis. $1,217,272. Metallic belt links for 7.62mm cartridges. St. Louis. Frankford Arsenal, Philadelphia.

—**KDI Corp.**, Cincinnati, Ohio. $1,048,489. Ammunition components. Cincinnati. Ammunition Procurement and Supply Agency, Joliet, Ill.

—**Kaiser Jeep Corp.**, Toledo, Ohio. $4,842,033; $28,636,803; and $19,423,263. 2½-ton trucks with Government furnished engines. Toledo and South Bend, Ind. Project Manager, General Purpose Vehicles. Army Mobility Command, Warren, Mich.

27—**D. E. Goodchild, Inc.**, Circleville, Ohio. $1,109,447. Paint Creek Reservoir, Ohio River Project, Highland, County, Ohio. Engineer Dist. Huntington, W. Va.

—**Silberberger Construction, Inc.**, Vista, Calif. $7,688,250. Dana Point Project. Dana Point Harbor, Calif. Engineer Dist., Los Angeles.

—**International Telephone & Telegraph**, Nutley, N.J. $2,509,300. Communications systems spare parts. Nutley. Army Electronics Command, Fort Monmouth, N.J.

—**Page Communications Engineers, Inc.**, Washington, D.C. $37,679,900. Integrated wide band communications system. Vietnam. Army Electronics Command, Fort Monmouth, N.J.

—**General Electric**, Red Bank, N.J. $3,197,978. Communications equipment maintenance sets and tool kits. West Lynn, Mass. Army Electronics Command, Fort Monmouth, N.J.

—**Control Data Corp.**, Rockville, Md. $2,000,000. Electronic equipment. Minneapolis, Minn. Army Electronics Command, Fort Monmouth, N.J.

—**Pettibone-Mulliken Corp.**, Washington, D.C. $1,003,209. Scoop type, 2½ cubic yd bucket loaders, Chicago. Army Mobility Equipment Center, St. Louis.

—**Federal Cartridge Corp.**, Minneapolis, Minn. $2,032,200. 5.56mm ammunition. Minneapolis. Army Ammunition Procurement & Supply Agency, Joliet, Ill.

—**General Motors, Allison Div.**, Indianapolis, Ind. $1,544,140. Steering gear assemblies for the M114 & M116 vehicles. Indianapolis. Army Tank Automotive Center, Warren, Mich.

—**General Motors, Allison Div.**, Indianapolis, Ind. $1,174,880. Transmission assemblies for tracked vehicles. Indianapolis. Army Tank-Automotive Center, Warren, Mich.

—**General Motors, Allison Div.**, Indianapolis, Ind. $3,147,000. Transmission assemblies for tanks. Indianapolis. Army Tank Automotive Center, Warren, Mich.

—**International Harvester Co.**, Chicago. $1,504,178. Truck tractors. Fort Wayne, Ind. Army Tank Automotive Center, Warren, Mich.

—**Mack Truck Co.**, Allentown, Pa. $1,676,962. 10 ton truck axle sets. Allentown. Army Tank Automotive Center, Warren, Mich.

—**FMC Corp.**, San Jose, Calif. $4,793,256. M113 personnel carriers and M548 cargo carriers. South Charleston, W. Va. Army Tank Automotive Center, Warren, Mich.

—**Vinnell Corp.**, Alhambra, Calif. $1,422,585. Electrical land distribution system for Vietnam. Vietnam and Los Angeles, Calif. Army Mobility Equipment Center, St. Louis.

—**Vinnell Corp.**, Alhambra, Calif. $2,918,353. Activation of T-2 oil tankers for operations as floating power bridges. Seattle, Wash., Mobile, Ala.; Jacksonville, Fla.; and Newport News, Va. Army Mobility Equipment Center, St. Louis, Mo.

—**Vinnell Corp.**, Alhambra, Calif. $1,950,000. Construction and operation of a maintenance facility in South Vietnam. Army Mobility Equipment Center, St. Louis.

—**Washington University**, St. Louis. $1,000,000. Research in micromodular computer systems. St. Louis. Defense Supply Service, Washington, D.C.

—**Martin-Marietta**, Baltimore, Md. $2,634,964. Demolition kits. Baltimore. Picatinny Arsenal, Dover, N.J.

—**Frequency Engineering Laboratories**, Framingdale, N.J. $6,374,615. AN/GRC-50 radio sets. Framingdale. Army Electronics Command, Philadelphia.

—**Delco Radio Div. of GMC**, Kokomo, Ind. $1,483,150. AN/PRT-4 radio transmitters and AN/PRR-9 radio receivers. Kokomo. Army Electronics Command, Philadelpha.

—**Stanford University**, Palo Alto, Calif. $1,402,801. Research of advance information processing. Palo Alto. Defense Supply Service, Washington, D.C.

—**Norris Thermador Corp.**, Los Angeles. $16,348,435. 81mm and 60mm projectiles and 105mm cartridge cases. River Bank Army Ammunition Plant, River Bank,

Calif. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Continental Motors Corp.**, Muskegon, Mich. $11,139,342. Five-ton truck multi-fuel engines. Muskegon. Project Manager, General Purpose Vehicles, Army Mobility Command, Warren, Mich.
—**Kaiser Jeep Corp.**, Toledo, Ohio. $47,175,-642. Five-ton trucks. South Bend, Ind. Project Manager, General Purpose Vehicles, Army Mobility Command, Warren, Mich.

28—**Electronic Assistance Corp.**, Red Bank, N.J. $1,096,122. Radio receivers. Red Bank. Army Electronics Command, Philadelphia.
—**Kaiser Jeep Corp.**, Toledo, Ohio. $4,473,-823. 5-ton wreckers. South Bend, Ind. Project Manager General Purpose Vehicles, Army Mobility Command, Warren, Mich.
—**Atlas Chemical Industries, Inc.**, Wilmington, Del. $14,713,613. TNT and O&MA activities. Volunteer Army Ammunition Plant, Chattanooga, Tenn. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Olin Mathieson Chemical Corp.**, New York City. $20,113,830. Propellants for small arms and rockets and O&MA activities. Badger Army Ammunition Plant, Baraboo, Wis. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Murphy Brothers, Inc.**, Spokane, Wash. $5,754,427. Construction on the Port Neuf River, Pocatello, Idaho, Local Protection Project. Pocatello. Engineer Dist., Walla Walla, Wash.
—**List & Clark Construction Co.**, Overland Park, Kan. $2,099,679. Perry Dam and Reservoir, Perry, Kans., Project. Completion of dam embankment. Engineer Dist., Kansas City, Mo.
—**Gahagan Dredging Corp.**, Tampa, Fla. $1,324,220. Galveston Harbor and Channel Project. Galveston, Tex. Engineer Dist., Galveston, Tex.
—**Southeast Drilling**, Denver, Colo. $1,231,-622. Classified construction. Work will be done at a classified area. Army Engineer Division, Mediterranean.
—**Halliburton Enterprises, Inc.**, Los Angeles. $1,606,968. Mono-pak containers for Redeye missiles. Los Angeles. Army Missile Command, Redstone Arsenal, Huntsville, Ala.
—**Harvey Aluminum, Inc.**, Torrance, Calif. $1,554,168. 40mm, M169, metal parts. Torrance. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Eagle Engineering Corp.**, Louisville, Ky. $1,381,944. Military standard small engine generator sets. Louisville. Army Mobility Equipment Center, St. Louis.
—**Hamilton Watch Co.**, Lancaster, Pa. $4,-606,511. Fuezs for artillery ammunition. Lancaster. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Ingraham Co.**, Bristol, Conn. $3,962,500. Fuzes for artillery ammunition. Bristol. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Stockton Port District**, Stockton, Calif. $5,196,083. Stevedoring services. Western Area, Military Traffic Management & Terminal Services, Oakland, Calif.
—**Honeywell, Inc.**, Hopkins, Minn. $1,625,-886. Fuzes, XM218 (loaded); grenade assemblies, M40. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Western Electric**, New York City. $1,893,260. Installation of Nike Hercules modification kits. Classified CONUS and overseas locations. Army Missile Command, Redstone Arsenal, Huntsville, Ala.
—**Grumman Air Engineering Corp.**, Long Island, N.Y. $1,246,000. Modifications on 16 OV-1 Mohawk aircraft. Beth Page, Long Island, N.Y. Army Aviation Material Command, St. Louis.
—**Chamberlain Corp.**, Waterloo, Iowa. $1,-206,765. Rocket warheads. Waterloo. Edgewood Arsenal, Md.
—**Bulova Watch Co. Inc.**, Providence, R. I. $2,945,504. Head assemblies for fuzes, (60mm projectile). Providence. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Honeywell, Inc.**, Hopkins, Minn. $24,956,-000. Fuzes, (40mm Projectile). Twin Cities Army Ammunition Plant, New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**K. P. Food Service of Fort Bliss, Inc.**, Springhill, La. $1,048,551. Kitchen police services for the period July 1, 1966 through June 30, 1967. Fort Bliss, Tex. Fort Bliss Purchasing & Contracting Office, Fort Bliss, Tex.
—**R.C.A.**, Camden, N.J. $3,958,948. Radio sets (AN/GRC-50), radio relay sets and light weight ground sets. Camden, N.J. Army Electronics Command, Philadelphia.

29—**University of Michigan**, Ann Arbor, Mich. $1,749,985. Maintenance and operation of the Mt. Haleakala observatory in Maui, Hawaii. Ann Arbor, Mich. and Maui, Hawaii. Defense Supply Service, Washington, D.C.
—**Rand Corp.**, Santa Monica, Calif. $1,329,-569. Research program of potential conflicts likely to arise in the next 10 years. Santa Monica. Defense Supply Service, Washington, D.C.
—**Rand Corp.**, Santa Monica, Calif. $3,402,-150. Theoretical conceptual studies of advanced military weapon systems and components. Santa Monica. Defense Supply Service, Washington, D.C.
—**Southwest Truck Body Co.**, St. Louis. $1,077,186. Semi-trailers. West Plains, Mo. Army Tank Automotive Center, Warren, Mich.
—**Southwest Truck Body Co.**, St. Louis. $2,867,887. semi-trailers. West Plains, Mo. Army Tank Automotive Center, Warren, Mich.
—**H. K. Ferguson Co.**, Cleveland, Ohio. $1,-341,700. Rehabilitation of the Cleveland Army Tank Automotive Plant. Engineer Dist., Louisville, Ky.
—**Bernard McMenamy Contractor, Inc.**, St. Charles, Mo. $1,869,400. Work on the Sny Island Levee Drainage District, Reach #3 Flood Control Project. Engineer Dist., Rock Island, Ill.
—**Pettibone Mulliken Corp.**, Chicago. $3,-600,000. 5,000-ton trucks. Chicago. Army Mobility Equipment Center, St. Louis.
—**FMC Corp.**, San Jose, Calif $2,449,500. XM501E3 Hawk loader Transporters. San Jose. Army Tank Automotive Center, Warren, Mich.
—**Garwood Industries, Inc.**, Wayne, Mich. $1,710,580. Assemblies and sub-assemblies for trucks. Wayne. Army Tank Automotive Center, Warren, Mich.
—**General Motors**, Pontiac, Mich. $5,649,202. Pontiac. Assemblies and sub-assemblies for trucks. Mansfield. Army Tank Automotive Center, Warren, Mich.
—**Mansfield Tire & Rubber Co.**, Mansfield, Ohio. $1,484,102. Tires for light trucks. Mansfield. Army Tank Automotive Center, Warren, Mich.
—**Holt Brothers**, Stockton, Calif. $2,273,926. Generator Sets. Stockton. Army Mobility Equipment Center, St. Louis.
—**Red River Army Depot**, Texarakana, Tex. $7,800,000. Conversion of M103A1 tanks to M103A2. Army Weapons Command, Rock Island Arsenal, Ill.
—**HRB Singer, Inc.**, State College, Pa. $4,-199,988. AN/AAS-14A infrared detecting sets, part of AN/UAS-4A infrared surveillance system. State College. Army Electronics Command, Philadelphia.
—**General Dynamics Electronics**, Rochester, N.Y. $4,686,700. Radio teletypewriter sets. Rochester. Army Electronics Command, Philadelphia.
—**Raytheon Co.**, Lexington, Mass. $2,074,710. Guidance and control system for Hawk. Lexington. Army Missile Command, Redstone Arsenal, Huntsville, Ala.
—**General Motors, Allison Div.**, Indianapolis, Ind. $1,780,646. Breech mechanism assemblies for 152 mm gun/launcher. Indianapolis. Watervliet Arsenal, N.Y.
—**General Motors, Allison Div.**, Indianapolis, Ind. $1,734,893. Breech mechanism assemblies for gun/launcher M60A1E1 tank turret. Indianapolis. Watervliet Arsenal, N.Y.
—**Alcan Aluminum Corp.**, Riverside, Calif. $1,319,827. M54 rocket motors. Riverside. Southwest Procurement Agency, Pasadena, Calif.
—**Philco Corp.**, Newport Beach, Calif. $5,-438,702. Six months industrial engineering servcies for the Shillelagh Missile. Newport Beach. Southwest Procurement Agency, Pasadena, Calif.
—**Sperry Rand Corp.**, Phoenix, Ariz. $3,200,-000. Radio magnetic compasses. Phoenix. Southwest Procurement Agency, Pasadena, Calif.
—**Stevens Mfg. Co.**, Ebensburg, Pa. $1,846,-628. Two-wheel cargo trailers, M416. Ebensburg. Army Tank Automotive Center, Warren, Mich.
—**Johnson Corp.**, Belleville, Ohio. $2,690,565. Cargo trailers, M105A2. Belleville. Army Tank Automotive Center, Warren, Mich.
—**General Dynamics**, San Diego, Calif. $1,300,000. Range measurement system testing with troops at Fort Ord, Calif. Northwest Procurement Agency, Oakland, Calif.
—**City Wide Janitorial Service**, Atlanta, Ga. $1,550,635. KP Services in 14 mess halls at Aberdeen Proving Grounds, Md. Aberdeen Proving Grounds, Md.
—**Lyles Construction Co.**, Montgomery, Ala. $2,102,994. Phase two of construction and rehabilitation of U.S. Army Training Centers. Fort Bragg, N.C. Engineer Dist., Savannah, Ga.
—**R.C.A.**, Camden, N.J. $3,800,480. Portable manpack FM radio sets. Camden. Army Electronics Command, Philadelphia.
—**Ingraham Co.**, Bristol, Conn. $1,252,304. Metal parts for the 4.2 mortar. Bristol. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Honeywell, Inc.**, Hopkins, Minn. $9,389,298. Fuzes. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**General Time Corp., Aeronetics Div.**, Stamford, Conn. $1,956,084. Bomb fuzes and metal parts. Gadsden, Ala. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Honeywell, Inc.**, Hopkins, Minn. $2,469,143. M-219 fuzes, components of cluster bomb units. New Brighton, Minn. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**A C F Industries, Carter Carburetor Div.**. St. Louis. $2,968,000. Fuzes and metal parts for 81mm mortar. Olivette, Mo. Ammunition Procurement & Supply Agency, Joliet, Ill.

30—**Cornell University**, Ithaca, N.Y. $2,291,000. Materials research program. Ithaca. Defense Supply Service.
—**University of Illinois**, Champagne-Urbana, Ill. $4,201,000. Materials research program. Urbana. Defense Supply Service.
—**Brown University**, Providence, R.I. $1,646,-250. Materials research program. Providence. Defense Supply Service.
—**University of Pennsylvania**, Philadelphia. $2,500,000. Materials research program. Philadelphia. Defense Supply Service.
—**University of Chicago**, Chicago, Ill. $1,-165,000. Materials research program. Chicago. Defense Supply Service.
—**Stanford University**, Palo Alto, Calif. $1,-276,000. Materials research program. Palo Alto. Defense Supply Service.
—**Northwestern University**, Evanston, Ill. $1,664,390. Materials research program. Evanston. Defense Supply Service.
—**M.I.T.**, Cambridge, Mass. $2,200,000. Materials research program. Cambridge. Defense Supply Service.
—**J. H. Pomeroy & Co. and M-B Contracting Co.**, San Francisco. $3,900,000. Runway improvements at Kadena AFB, Okinawa. Engineer Dist., Okinawa.
—**Farmers Chemical Association**, Tyner, Tenn. $2,727,950. Manufacture of TNT. Chattanooga, Tenn. Ammunition Procurement & Supply Agency, Joliet, Ill.
—**Philco Corp.**, Newport Beach, Calif. $1,-015,560. Additional equipment for the Shillelagh missile. Newport Beach. Army Missile Command, Huntsville, Ala.
—**Philco Corp.**, Newport Beach, Calif. $1,-624,890. Research and development in support of the Shillelagh missile system. Newport Beach. Army Missile Command, Huntsville, Ala.
—**Sperry Rand Corp.**, Salt Lake City, Utah. $1,133,913. Engineering services for the Sergeant missile system. Salt Lake City. Army Missile Command, Huntsville, Ala.
—**Sperry Rand Corp.**, Salt Lake City, Utah. $4,700,000. Sergeant missile body section and control surface assemblies. Salt Lake City. Army Missile Command, Huntsville, Ala.
—**Bell Helicopter Co.**, Fort Worth, Tex. $1,-000,072. Increased production improvement for UH-1 helicopters. Tarrant County, Tex. Army Aviation Materiel Command, St. Louis.
—**AVCO Corp.**, Stratford, Conn. $2,934,035. Materials and services for CY 66 production improvement program on UH-1 helicopters. Stratford. Army Aviation Materieli Command, St. Louis.
—**AVCO Corp.**, Stratford, Conn. $22,107,483. Engines for UH-1 helicopters. Stratford. Army Aviation Materiel Command, St. Louis.
—**General Motors, Allison Div.**, Indianapolis, Ind. $1,012,264. Engines for LOH aircraft. Indianapolis. Army Aviation Materiel Command, St. Louis.
—**Marvel Mfg. Co.**, Washington, D.C. $1,511,-266. Aircraft propeller and rotor wing balancing equipment. Caldwell, N.J. Army Aviation Materiel Command, St. Louis.
—**United Aircraft, Sikorsky Aircraft Div.**, Stratford, Conn. $7,500,000. CH-54A heavy lift cargo helicopters. Stratford.

Army Aviation Materiel Command, St. Louis.

—**Bell Helicopter Co.**, Fort Worth, Tex. $1,011,200. Configuration change to UH-1D and UH-1B utility helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis.

—**Boeing Co., Vertol Div.**, Morton, Pa. $3,260,169. CH-47 (Chinook) spare parts. Morton. Army Aviation Materiel Command, St. Louis.

—**Bell Helicopter Co.**, Fort Worth, Tex. $9,457,443. UH-1B and UH-1D utility helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis.

—**United Aircraft, Sikorsky A/C Div.**, Stratford, Conn. $2,000,000. Training devices for CH54A heavy lift cargo helicopters. Stratford. Army Aviation Materiel Command, St. Louis.

—**Brezina Construction Co.**, Salt Lake City, Utah. $1,211,000. Tower grid modernization. Dugway Proving Ground, Utah. Engineer Dist., Sacramento, Calif.

—**Hughes Aircraft**, Culver City, Calif. $3,098,000. Advanced production engineering on TOW. Tucson, Ariz. Army Missile Command, Huntsville, Ala.

—**J. H. Beers, Inc.**, Bangor, Pa. $1,428,611. Work on the Beltsville Dam and Reservoir Project. Lehighton, Pa. Engineer Dist., Philadelphia.

—**Bowen-McLaughlin-York**, York, Pa. $1,531,000. Utility truck platforms. York. Army Tank Automotive Center, Warren, Mich.

—**North American Aviation**, Anaheim, Calif. $1,331,660. Automatic data processing facility. Anaheim and Washington, D.C. Army Map Service, Corps of Engineers.

—**Stevens Mfg. Co.**, Ebensburg, Pa. $1,258,219. Cargo trailers and chassis. Ebensburg. Army Tank Automotive Center, Warren, Mich.

—**Continental Motors**, Muskegon, Mich. $3,577,100. Engine assembly with tank containers. Muskegon. Army Tank Automotive Center, Warren, Mich.

—**Case-Master Body, Inc.**, Rose City, Mich. $2,699,371. Water tank trucks. Rose City. Army Tank Automotive Center, Warren, Mich.

—**N. H. Spinks, Sr., Ent., Inc.**, Fort Worth, Tex. $1,064,336. UH-1 utility helicopter seats. Forth Worth. Army Aviation Materiel Command, St. Louis.

—**International Harvester Co.**, San Diego, Calif. $2,262,581. Auxiliary power units for CH-47 helicopters. San Diego. Army Aviation Materiel Command, St. Louis.

—**Boeing Co., Vertol Div.**, Morton, Pa. $2,970,000. Rate tooling applicable to CH-47 aircraft. Morton. Army Aviation Materiel Command, St. Louis.

—**Aerojet General Corp.**, Azusa, Calif. $1,746,428. UH-1 aircraft shell armor seats. Azusa. Army Aviation Materiel Command, St. Louis.

—**Raytheon Co.**, Lexington, Mass. $3,500,000. Engineering services for the Hawk missile system. Andover, Mass. Army Missile Command, Huntsville, Ala.

—**Raytheon Co.**, Lexington, Mass. $1,600,000. Engineering services, quality assurance and control for the Hawk missile system. Andover, Mass. Army Missile Command, Huntsville, Ala.

—**Raytheon Co.**, Lexington, Mass. $1,762,115. Engineering change orders for selected items for the Hawk missile system. Andover, Mass. Army Missile Command, Huntsville, Ala.

—**Raytheon Co.**, Lexington, Mass. $11,907,058. Selected items for the Hawk missile system. Andover and Waltham, Mass. Army Missile Command, Huntsville, Ala.

—**Norris Thermador Corp.**, Los Angeles. $1,611,500. Projectiles. Los Angeles. Southwest Procurement Agency, Pasadena, Calif.

—**General Electric**, Pittsfield, Mass. $3,384,146. Research and development work. Pittsfield, Mass.; Syracuse and Schenectady, N.Y. Aberdeen Proving Ground, Md.

—**Raytheon Co.**, Wayland, Mass. $1,051,097. Services and materials for ABAR radar sets. Wayland. Army Electronics Command, Philadelphia.

—**General Dynamics**, Electronics Div., Rochester, N.Y. $1,478,877. HF/SSB simulators. Rochester. Army Electronics Command, Philadelphia.

—**Astro Communication Labs, Inc.**, Gaithersburg, Md. $1,072,300. Classified electronic equipment. Gaithersburg. Army Electronics Command, Fort Monmouth, N.J.

—**Tridea Electronics Corp.**, South Pasadena, Calif. $1,356,365. Radio beacons. South Pasadena. Army Electronics Command, Philadelphia.

—**Collins Radio Co.**, Dallas, Tex. $1,754,108. Radio Sets. Richardson, Tex. Army Electronics Command, Philadelphia.

—**General Motors**, Indianapolis, Ind. $1,012,938. Transmissions used in the M107, M110 and M578 vehicles. Indianapolis. Army Tank Automotive Center, Warren, Mich.

—**Institute of Defense Analysis**, Arlington, Va. $2,456,983. Research surveys and analysis. Arlington. Defense Supply Service.

—**Institute of Defense Analysis**, Arlington, Va. Research and analysis on military and scientific capabilities. Arlington. Defense Supply Service.

—**Bowen-McLaughlin-York, Inc.**, York, Pa. $4,183,880. Self-propelled guns, howitzers & vehicles. York. Army Tank Automotive Center, Warren, Mich.

—**Chrysler Motors**, Detroit. $7,463,604. Cargo trucks. Detroit. Army Tank Automotive Center, Warren, Mich.

—**Microdot, Inc.**, South Pasadena, Calif. Modulation calibrator. South Pasadena. Frankford Arsenal, Philadelphia.

—**General Dynamics**, Pomona, Calif. $1,247,000. Line items of maintenance equipment and documentation for depot rebuild capabilities for Toole Depot. Pomona. Army Missile Command, Redstone Arsenal, Huntsville, Ala.

—**Pace Corp.**, Memphis, Tenn. $1,118,132. Surface trip flare, M49A1. Memphis. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Collins Radio Co.**, Richardson, Tex. $4,080,084. Radio sets. Richardson. Army Electronics Command, Fort Monmouth, N.J.

—**Collins Radio Co.**, Richardson, Tex. $4,347,641. Radio sets. Richardson. Army Electronics Command, Fort Monmouth, N.J.

—**Sylvania Electric Products, Inc.**, Mountain View, Calif. $1,500,000. Classified electronics equipment. Mountain View. Army Electronics Command, Fort Monmouth, N.J.

—**Philco Corp.**, Newport Beach, Calif. $1,327,738. Guidance & control components for the Shillelagh Missile system. Newport Beach. Army Missile Command, Redstone Arsenal, Huntsville, Ala.

—**Continental Motors Corp.**, Muskegon, Mich. $1,369,993. Engines for the M60 tank. Muskegon. Army Tank Automotive Center, Warren, Mich.

—**Boeing Co., Vertol Div.**, Morton, Pa. $2,970,000. Increasing the production capabilities of the CH-47 aircraft. Morton. Army Aviation Materiel Command, St. Louis.

—**International Telephone & Telegraph Corp.**, Nutley, N.J. $1,500,000. Radio assemblages. Nutley. Army Electronics Command, Fort Monmouth, N.J.

—**Hughes Aircraft Co.**, Fullerton, Calif. $2,003,257. Radio sets. Fullerton, Army Electronics Command, Philadelphia.

—**LTV, Electro System, Inc.**, Greenville, Tex. $3,071,102. Modification of U-8D & U-6A aircraft. Greenville. Army Aviation Material Command, St. Louis.

—**General Motors, Allison Div.**, Indianapolis, Ind. $1,211,975. Transmissions for combat vehicle M48 & M103. Indianapolis. Army Tank Automotive Center, Warren, Mich.

—**Hupp Corp.**, Canton, Ohio $13,838,175. Multi-fuel engines for trucks. Canton. Project Manager, General Purpose Vehicles, Army Mobility Command, Warren, Mich.

—**MIT, Div. of Sponsored Research**, Cambridge, Mass. $1,275,000. One-year of basic & applied research. Cambridge Army Electronics Command, Fort Monmouth, N.J.

—**Chamberlain Corp.**, Waterloo, Iowa. $6,207,082. Projectiles. Army Ammunition Plant, Scranton, Pa. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**FMC Corp.**, Santa Clara, Calif. $3,150,000. Projectiles for 4.2 inch mortar shells. Santa Clara, Calif. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Norris Thermador Corp.**, Vernon, Calif. $1,799,607. New production equipment to manufacture the 81mm mortar shell and reactivation costs of the Riverbank Army Ammunition Plant, Calif. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**REDM Corp.**, Wayne, N.J. $7,720,488. Head assemblies for fuzes. Wayne. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Carter Carburetor Co.**, St. Louis. $1,646,774. Point detonating fuzes. Olivette, Mo. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Strong Electric Co.**, Toledo, Ohio. $1,451,195. Searchlights. Toledo. Army Electronics Command, Fort Monmouth, N.J.

—**White Motor Corp.**, Lansing, Mich. $1,510,629. Production and inspection for M600 vehicles. Lansing. Project Manager, General Purpose Vehicles. Army Mobility Command, Warren, Mich.

—**Bell Helicopter Co.**, Fort Worth, Tex. $1,758,763. UH-1 helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis.

—**American Machine & Foundry Co.**, Brooklyn, N.Y. $4,783,928. Demolition bombs. Brooklyn. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Sylvania Electric Products, Inc.**, Emporium, Pa. $1,164,630. Fuzes. Emporium. Picatinny Arsenal, Dover, N.J.

—**Bowen McLaughlin-York**, York, Pa. $7,216,714. Self-propelled guns, Howitzers and recovery vehicles. York. Army Tank Automotive Center, Warren, Mich.

—**Collins Radio Co.**, Cedar Rapids, Iowa. $4,258,625. Radio sets. Cedar Rapids. Army Electronics Command, Fort Monmouth, N.J.

—**Raytheon Co.**, Bristol, Tenn. $5,509,350. Bomb fuezs. Bristol. Picatinny Arsenal, Dover, N.J.

—**Motorola, Inc.**, Chicago. $5,446,287. Bomb fuzes. Chicago. Picatinny Arsenal, Dover, N.J.

—**Firestone Tire & Rubber Co.**, Akron, Ohio. $1,132,047. Combat tanks, M48 series. Akron. Watervliet Arsenal, N.Y.

—**Zenith Radio Corp.**, Chicago. $10,529,442. Bomb fuzes. Chicago. Picatinny Arsenal, Dover, N.J.

—**RCA**, Lancaster, Pa. $1,000,000. Image intensifier assemblies. Lancaster. Army Electronics Command, Fort Monmouth, N.J.

—**Varo Inc.**, Garland, Tex. $1,000,000. Starlight scopes. Garland. Army Electronics Command, Fort Monmouth, N.J.

—**RCA**, Burlington, Mass. $2,300,000. Depot installed maintenance automatic test equipment (DIMATE). Burlington. Army Electronics Command, Fort Monmouth, N.J.

—**Canadian Commercial Corp.**, Ottawa, Canada. $2,289,194. TNT. Valleyfield and McMasterville, Quebec. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**I. D. Precision Components, Inc.**, Jamaica, N.Y. $1,658,525. Boosters with loaded detonators. Gadsden, Ala. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Emerson Electric Co.**, St. Louis. $1,230,381. Rocket motors; pedestal and engineering services ofr Honest John Missiles. St. Louis. Army Missile Command, Redstone Arsenal, Huntsville, Ala.

—**R. G. LeTourneau, Inc.**, Longview, Tex. $3,100,064. Bomb demolition. Longview. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Raytheon Co.**, Lexington, Mass. $4,558,919. Bomb fuzes. Bristol, Tenn. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**A. O. Smith Corp.**, Chicago. $3,365,032. Demolition bombs. Waco, Tex. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Amron Corp.**, Waukesha, Wis. $2,677,201. Cartridges. Waukesha. Frankford Arsenal, Philadelphia.

—**Harvey Aluminum, Inc.**, Torrance, Calif. $2,370,000. Projectiles. Torrance. Frankford Arsenal, Philadelphia.

—**General Time Corp., Westclox Div.**, LaSalle, Ill. $13,983,929. Fuzes for artillery ammunition. LaSalle. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Hughes Aircraft.**, Culver City, Calif. $7,100,000. TOW/helicopters. Culver City. Army Missile Command, Redstone Arsenal, Huntsville, Ala.

—**Ford Motors**, Dearborn, Mich. $1,588,450. Production & inspection engineering services on M151A1 trucks. Dearborn. Project Manager, General Purpose Vehicles. Army Mobility Command, Warren, Mich.

—**Eureka Williams Co.**, Bloomington, Ill. $2,091,889. Bomb fuzes. Bloomington. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**Raytheon Co.**, Lexington, Mass. $1,200,000. Hawk missiles. Andover, Mass. Army Missile Command, Redstone Arsenal, Huntsville, Ala.

—**Bendix Corp.**, Baltimore, Md. $1,816,423. Development of a portable alarm. Baltimore. Edgewood Arsenal, Md.

—**DeLong Corp.**, New York, N.Y. $1,800,000. Trestles and auxiliary equipment, services and towing. Hong Kong. Army Mobility Equipment Center, St. Louis.

—**American Hoist & Derrick Co.**, St. Paul, Minn. $1,411,920. Truck-mounted crane shovels. St. Paul. Army Mobility Equipment Center, St. Louis, Mo.

—**E. I. DuPont Denemours & Co.**, Wilming-

ton, Del. $1,239,106. TNT. Barksdale, Wis. Ammunition Procurement & Supply Agency, Joliet, Ill.

—**RCA**, Camden, N.J. $1,500,000. Classified research & development electronic equipment. Camden. Army Electronics Command, Ft. Monmouth, N.J.

—**Bell Helicopter Co.**, Ft. Worth, Tex. $2,-350,104. Blade assemblies for UH-1 helicopters. Fort Worth. Army Aviation Materiel Command, St. Louis, Mo.

NAVY

1—**Deco Electronics**, Washington, D.C. $6,-691,589. Communications equipment for naval ships. McLean, Va. Naval Ship Systems Command.

—**General Electric**, Washington, D.C. $1,-348,795. Development of coating processes and equipment to improve the reliability of the LM-1500 gas turbine engine for marine use. Evendale, Ohio. Naval Ship Systems Command.

—**Zenith Radio Corp.**, Chicago. $2,478,923. Target detecting devices for Sidewinder missiles. Chicago. Naval Air Systems Command.

—**Westinghouse Electric**, Baltimore, Md. $4,230,000. Airborne radar sets for the Air Force. Baltimore. Naval Air Systems Command.

—**Douglas Aircraft**, Long Beach, Calif. $3,-700,000. TA-4E aircraft. Long Beach. Naval Air Systems Command.

—**Raytheon Co.**, Lexington, Mass. $2,873,-230. Airborne radar sets. Bristol, Tenn. Naval Air Systems Command.

—**Sargent-Fletcher Co.**, El Monte, Calif. $2,246,184. Mark 77 fire bombs. El Monte. Navy Ordnance Plant, Louisville, Ky.

—**Raytheon Co.**, Portsmouth, R.I. $12,345,500. Sonar equipment for installation on naval ships. Portsmouth. Naval Ship Systems Command.

—**Gorham Corp.**, Waltham, Mass. $5,511,042. Communications equipment for naval ships. Waltham. Naval Ships Systems Command.

—**Honeywell, Inc.**, Seattle, Wash. $1,070,175. Telegraph terminal equipment for naval ships. Seattle. Naval Ship Systems Command.

—**Collins Radio Co.**, Richardson, Tex. $3,-570,000. 68 transportable communication centrals (AN/TSC-15). Cedar Rapids, Iowa. U.S. Marine Corps.

2—**Aluminum Company of America**, Pittsburgh, Pa. $3,373,500. Motor tubes for 2.75 inch rockets. New Kensington, Pa. Naval Ships Parts Control Center, Mechanicsburg, Pa.

3—**Southeastern Electric Contracting Co.**, and **Volta Electric Co.**, Virginia Beach, Va. $1,356,300. Construction of an electrical distribution system at the Sewells Point Area, Naval Station, Norfolk, Va. Atlantic Div., Naval Facilities Engineering Command.

—**North American Aviation**, Columbus, Ohio. $1,172,000. Conversion of A-5A weapons systems to RA-5C configuration. Columbus. Naval Air Systems Command.

—**Bunker-Ramo Corp.**, Canoga Park, Calif. $2,147,692. Digital data computers. Canoga Park. Naval Ship Systems Command.

—**General Instrument Corp.**, Hicksville, N.Y. $1,750,000. Battlefield surveillance radars. Hicksville. Naval Ship Systems Command.

—**RCA**, Camden, N.J. $6,414,377. $1,592,691. Classified communications countermeasure equipment. Camden. Naval Ship Systems Command.

6—**Technical Material Corp.**, Mamaroneck, N.Y. $3,440,210. Radio communications systems for shore electronics systems. Mamaroneck. Navy Purchasing Office, Washington, D.C.

—**General Electric**, Seattle, Wash. $3,367,600. Main propulsion units for supply ships. West Lynn, Mass. Puget Sound Naval Shipyard, Bremerton, Wash.

—**NU-Pak Co.**, Parksburg, Pa. $3,306,205. Steel pallets for use in transporting bombs. Parksburg. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**Garrett Corp., AiResearch Mfg. div.**, Los Angeles. $3,853,660. Compressor power units and gas turbine compressor power engines. Los Angeles. Naval Air Systems Command.

—**Raytheon Co.**, Lexington, Mass. $2,930,002. Radar sets and related equipment. North Dighton, Mass. Naval Air Systems Command.

—**Yankee Walter Corp.**, Los Angeles. $4,-168,571. Fire fighting trucks for use at Navy and Marine Corps airfields. Vorheesville, N.Y. and Los Angeles. Navy Purchasing Office, Washington, D.C.

—**Babcock & Wilcox Co.**, Seattle, Wash. $1,057,585. Main boilers for supply ships. Seattle. Puget Sound Naval Shipyard, Bremerton, Wash.

—**Admiral Corp.**, Chicago. $1,508,315. Parts for airborne radio communication equipment. Chicago. Naval Aviation Supply Office, Philadelphia.

7—**Sperry Rand Corp.**, Charlottesville, Va. $1,908,112. Stabilized master compass & binnacle control cabinets & associated power supply & bridge alarm indicator equipment. Charlottesville. Naval Ship Systems Command.

—**Kollmorgen Corp.**, Northampton, Mass. $1,885,668. Periscope systems, including adapters, repair parts & associated technical data. Northampton. Naval Ship Systems Command.

—**FMC Corp.**, San Jose, Calif. $1,250,764. Modernization of LVTH6 vehicles (landing Vehicle Tracked Howitzer) to LVTH6A1 configuration. San Jose. Marine Corps Headquarters.

8—**United Aircraft Corp.**, Pratt & Whitney Aircraft Div., E. Hartford, Conn. $4,000,-000. Phase II of development of the TF-30-P-12 engine. E. Hartford. Naval Air Systems Command.

—**Bendix Corp.**, Baltimore, Md. $3,220,185. Airborne Radio receiver-transmitter sets and related equipment. Baltimore. Naval Air Systems Command.

—**United Aircraft Corp.**, Hamilton Standard Div., Windsor Locks, Conn. $6,874,536. Aircraft propellers & related components. Windsor Locks. Naval Air Systems Command.

—**Litton Systems, Inc.**, Woodland Hills, Calif. $1,200,893. Components for AN/ASQ-61 ballistic computer systems for A-6A aircraft. Navy Aviation Supply Office, Philadelphia.

—**Conco Engineering Works, Inc.**, Mendota, Ill. $1,115,423. Mark 77 fire bombs. Mendota. Naval Ordnance Plant, Louisville, Ky.

—**Harvey Aluminum, Inc.**, Torrance, Calif. $5,684,445. Projectiles for loading 20mm ammunition. Torrance. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**General Dynamics Corp.**, Electric Boat Div. Groton, Conn. $3,145,293. Classified research and development equipment. Groton. Naval Ship Systems Command.

—**Collins Radio Co.**, Cedar Rapids, Iowa. $3,234,830. Communication, navigation & identification systems. Cedar Rapids. Naval Air Systems Command.

9—**LTV Aerospace Corp.**, Dallas, Tex. $1,335,-000. Acquisition & installation of milling machines. Dallas. Naval Air Systems Command.

—**Washington Aluminum Co.**, Baltimore, Md. $1,314,678. Fabrication of MA-2 pallet & mat assemblies for use in SATS (Short Airfield for Tactical Support) airfields. Baltimore. Naval Air Engineering Center Philadelphia.

—**Borg Warner Corp.**, Philadelphia. $1,-611,315. High-speed paper tape reading & punching systems with related data & repair parts. Philadelphia. Naval Supply Systems Command.

10—**Turnbull Elevator Inc.**, Erie, Pa. $1,196,943. Electromechanical elevators for AOE3 supply ships. Erie. Puget Sound Naval Shipyard, Bremerton, Wash.

—**Raytheon Co.**, Lexington, Mass. $3,150,000. Airborne radar sets & related equipment for the Air Force. Bristol, Tenn. & Bedford, Mass. Naval Air Systems Command.

—**Liles Construction Co.**, Montgomery, Ala. $1,158,200. Rehabilitation of BOQ & EM barracks at NALF Ellyson Field, Pensacola, Fla. Naval Facilities Engineering Command.

13—**Collins Radio Co.**, Cedar Rapids, Iowa. $3,799,277. Communications equipment for installation on naval ships. Cedar Rapids. Naval Ship Systems Command.

—**Ries Construction Co.**, San Diego, Calif. $1,136,442. Construction & rehabilitation of EM barracks at the Naval Auxiliary Air Station, Ream Field, Imperial Beach, Calif. Naval Facilities Engineering Command.

—**Edward R. Marden Corp.**, Allston, Mass. $2,169,600. Construction of an aircraft maintenance hanger at the Naval Air Station, South Weymouth, Mass. Naval Facilities Engineer Command.

—**Computer Measurements Co.**, San Fernando, Calif. $2,395,185. Electrical equipment (AN/USM-207). San Fernando. Navy Purchasing Office, Washington, D.C.

—**Hughes Aircraft**, Culver City, Calif. $3,-362,100. Additional FY 66 funding for the Phoenix missile system. Culver City. Naval Air Systems Command.

—**Sanders Associates, Inc.**, Nashua, N. H. $1,800,000. Research & development on electronic equipment. Nashua. Naval Air Systems Command.

—**Grumman Aircraft Engineering Corp.**, Bethpage, L.I., N.Y. $10,028,000. FY 66 procurement of A-6A & EA-6B aircraft. Bethpage Naval Air Systems Command.

14—**Sperry Rand Corp.**, Great Neck, L. I., N.Y. $17,891,530. Fabrication & test of prototype models of the Phase II integrated light attack Avionics System (ILAAS). Great Neck. Naval Air Systems Command.

—**Hercules Inc.**, Cumberland, Md. $1,147,000. Research & development work on propellants. Cumberland. Naval Ordnance Systems Command.

—**Grumman Aircraft Engineering Corp.**, Bethpage, L.I., N.Y. $5,000,000. E-2A aircraft. Bethpage. Naval Air Systems Command.

—**Westinghouse Electric**, Baltimore, Md. $4,-835,125. AN/APG-59 radar sets. Baltimore. Naval Air Systems Command.

—**General Electric**, Washington, D.C. $6,331,-257. MK 412 Module Test Sets. Pittsfield, Mass. Special Project Office.

—**McDonnell Aircraft Corp.**, St. Louis. (1) $140,600,000. To increase long lead time effort for FY 66 procurement of F-4E, F-4J, F-4D and RF-4C aircraft for the Navy and Air Force; (2) $3,500,000. Long lead time effort to support procurement of F-4D mobile training units & technical Publications. St. Louis. Naval Air Systems Command.

—**Sperry Rand Corp.**, Great Neck, L. I., N.Y. $1,180,000. Research & development work on the TALOS missile. Great Neck. Naval Ordnance Systems Command.

15—**Frequency Engineering Laboratories**, Farmingdale, N.J. $1,617,250. Classified electronics equipment. Farmingdale. Naval Ship Systems Command.

16—**Boatel Co., Inc.**, Mora, Minn. $1,485,600. 56-foot mechanized landing craft (LCM 6). Mora. Naval Ship Systems Command.

—**Miami Beach Yacht Corp.**, Miami, Fla. $2,267,529. 36-foot plastic landing craft (LCPL). Miami. Naval Ship Systems Command.

—**Marinette Marine Corp.**, Marinette, Wis. (1) $2,391,000. Four large harbor tugs (YTB). (2) $5,549,600. 28 aluminum mechanized landing craft (LCM). Marinette. Naval Ship Systems Command.

—**General Dynamics Corp.**, Electric Boat Div., Groton, Conn. $3,269,267. Two deep research vehicles. Groton. Naval Ship Systems Command.

—**Ingalls Shipbuilding Corp.**, Pascagoula, Miss. $37,874,470. An amphibious assault ship (LPH). Pascagoula. Naval Ship Systems Command.

—**General Electric**, Washington, D.C. $1,-606,500. Gas generators & power turbines for installation on naval ships. Evendale, Ohio. Naval Ship Systems Command.

17—**John C. Grimberg Co.**, Rockville, Md. $3,194,000. Construction of an inert diluent production plant facility at the Naval Propellant Plant, Indian Head, Md. Chesapeake Div., Naval Facilities Engineering Command.

—**Electronic Communications, Inc.**, St. Petersburg, Fla. $1,455,000. Radio sets and related equipment and services. St. Petersburg. Naval Ship Systems Command.

—**Reeves Instrument Co.**, Garden City, N.Y. $2,612,880. Vehicle gyro compass systems for installation on naval surface ships. Garden City. Naval Ship Systems Command.

—**Sundstrand Corp.**, Rockford, Ill. $1,345,248. Constant speed drives for A-7A aircraft. Rockford. Navy Aviation Supply Office, Philadelphia.

—**General Electric**. Evendale, Ohio. $1,-122,094. Spare parts for J79GE10 engines. Evendale. Navy Aviation Supply Office, Philadelphia.

—**R. F. Communications, Inc.**, Rochester, N.Y. $1,585,923. Electronic copler groups for naval ships. Rochester. Naval Ship Systems Command.

—**Texas Instrument, Inc.**, Dallas, Tex. $2,-408,080. APQ-116 radar system components for A-7A aircraft. Dallas. Navy Aviation Supply Office, Philadelphia.

—**United Aircraft**, Stratford, Conn. $2,458,-000. Engine components for initial outfitting of CH-53A aircraft. Stratford. Navy Aviation Supply Office, Philadelphia.

20—**Giannini Controls Corp.**, Fairfield, N.J. $1,609,901. Spare parts to support central

air data computer systems for A-6A, EA-6A & E-2A aircraft. Fairfield. Navy Aviation Supply Office, Philadelphia.

—**Hickok Electrical Instrument Co.**, Cleveland, Ohio. $2,364,368. Oscilloscopes. Greenwood, Miss. Naval Ship Systems Command.

—**Collins Radio Co.**, Dallas, Texas. $2,000,000. Radio communications & data terminal equipment. Cedar Rapids, Iowa (35%), Richardson, Tex. (65%). Naval Ship Systems Command.

21—**Hewlett-Packard**, Rockville, Md. $1,015,341. Power measuring sets, power meters & related equipment. Palo Alto, Calif. Naval Ship Systems Command.

—**Sperry Rand Corp.**, Long Island, N.Y. $1,482,590. World-wide repair, maintenance, alteration & installation of the TARTAR/TERRIER missile system for FY 67. Long Island. Navy Purchasing Office, Los Angeles.

—**Unaka Corp.**, Greenville, Tenn. $2,168,039. (Mark 82, Mod 1) bomb fins for 500 lb bombs. Greenville. Navy Ships Part Control Center, Mechanicsburg, Pa.

—**Poloron Products Inc.**, New Rochelle, N.Y. $2,008,708. Bomb fins for 500 lb bombs. Scranton, Pa. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**General Time Corp.**, LaSalle, Ill. $1,031,404. Mark 188 rocket fuses. Peru, Ill. Ships Parts Control Center, Mechanicsburg, Pa.

—**Dow Chemical Co.**, Camden, N.J. $6,545,022. AM-2 aluminum mat extrusions for airfields. Madison, Ill. Naval Air Engineering Center, Philadelphia.

—**Kaiser Aluminum & Chemical Sales, Inc.** Halethorpe, Md. $7,687,248. AM-2 aluminum mat extrusions. Halethorpe. Naval Air Engineering Center, Philadelphia.

—**Aluminum Co. of America**, Pittsburgh, Pa. $1,094,448. AM–2 aluminum mat extrusions. Lafayette, Ind. Naval Air Engineering Center, Philadelphia.

—**American Machine & Foundry Co.**, York, Pa. $1,233,480. Mark 56 mine anchors & for work on the Mark 56 underwater mine program. York. Naval Ordnance Plant, Louisville, Ky.

—**Goodyear Aerospace Corp.**, Akron, Ohio. $2,172,861. Refurbishing & updating of the A–6A weapons systems trainers. Akron. Naval Training Device Center, Orlando, Fla.

—**General Precision Inc.**, Binghamton, N.Y. $4,131,454. Six F–4C training sets to F–4D training sets. Binghamton (80%) Riverdale, Md. Naval Training Device Center, Orlando, Fla.

22—**Honeywell Inc.**, Hopkins, Minn. $2,055,261. Design, development & fabrication of automatic tooling for the Rockeye II weapon system. Hopkins. Navy Purchasing Office, Los Angeles.

—**Pioneer Aerodynamics Systems**, Manchester, Conn. $1,029,800. Parachute & container assemblies for Mark 24 flares. Columbia, Miss. Naval Ammunition Depot Crane, Ind.

—**Sanders Associates, Inc.**, Nashua, N. H. $12,578,640. Classified electronic equipment. Nashua. Naval Air Systems Command.

—**Westinghouse Electric Corp.**, Baltimore, Md. $29,836,692. AN/APG–59 radar sets. Baltimore. Naval Air Systems Command.

—**United Aircraft**, East Hartford, Conn. $1,048,600. Gas turbine engine program for marine application. East Hartford. Naval Ship Systems Command.

23—**Goodyear Aerospace Corp.**, Akron, Ohio. $1,526,390. One prototype aircraft carrier landing device (2–H–87). Akron. Naval Training Device Center, Port Washington, N.Y.

—**Maxon Electronics Corp.**, Macon, Ga. $1,068,054. Mark 83 Mod O fuses for five-inch 38 caliber guns. Macon. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**North American Aviation, Inc.**, Anaheim, Calif. $1,943,750. Ships Inertial Navigation System (SINS) conversion kits with ancillary equipment. Anaheim. Naval Ship Systems Command.

—**Gyrodyne Co., of America, Inc.**, St. James, L.I., N.Y. $11,396,000. QH–50D drone helicopters. St. James. Naval Air Systems Command.

—**Honeywell Inc.**, Hopkins, Minn. $1,069,694. Short fuel tanks, extended sections & periodic testing of the MK 46 torpedo. Hopkins. Naval Ordnance Systems Command.

—**T. M. C. Systems Inc.**, Alexandria, Va. $2,979,417. Portable transmitter station consisting of 18 communication bands for installation overseas. Navy Purchasing Office, Washington, D.C.

24—**Greenhut Construction Co., Inc.** Pensacola, Fla. $1,239,958. Construction of an aircraft maintenance hanger at the Naval Air Auxiliary Station, Whiting Field, Milton, Fla. Southeast Div., Naval Facilities Engineering Command.

—**International Builders of Florida, Inc.**, Coral Gables, Fla. $2,084,000. Construction of a bachelor officers quarters and mess at the Naval Air Auxiliary Station, Saufley Field, Pensacola, Fla. Southeast Div., Naval Facilities Engineering Command.

—**Dyson & Co.**, Pensacola, Fla. $2,379,000. Construction of a bachelor officers quarters & mess at the Naval Air Auxiliary Station. Whiting Field, Milton, Fla. Naval Facilities Engineering Command.

—**George Hyman Construction Co.**, Washington, D.C. $10,072,000. Construction of a science building at the Naval Academy, Annapolis, Md. Chesapeake Div., Naval Facilities Engineering Command.

—**Anaconda Wire & Cable Co.**, New York City. $3,245,096. Minesweeping cable. Hastings-on-Hudson, N.Y. Naval Ship Systems Command.

—**Peter Kiewit Sons Co.**, Richmond, Calif. $4,895,000. Extension to ammunition piers at the Naval Weapons Station, Concord, Calif. Western Div., Naval Facilities Engineering Command.

—**U.S. Steel Corp.**, Washington, D.C. $3,150,000. Research & development of submarine hull construction. Monroeville, Pa. Naval Ship Systems Command.

27—**ITT Laboratories**, Nutley, N.J. $3,580,956. Portable radio transmitter-receivers & related items. Camden, Ark. Naval Ship Systems Command.

R.C.A., Defense Electronic Products Div., Camden, N.J. $1,471,359. Airborne Radio receiving sets and related equipment. Camden. Naval Air Systems Command.

—**Collins Radio Co.**, Cedar Rapids, Iowa. $11,533,468. Communication, navigation, identification systems. Cedar Rapids. Naval Air Systems Command.

—**United Aircraft, Pratt & Whitney Aircraft Div.**, East Hartford, Conn. $3,342,950. Spare parts used to retrofit J–48, P–6A/8A engines on F–9F aircraft. East Hartford. Naval Aviation Supply Office, Philadelphia.

—**Standard Screw Co., Western Div.**, Elyria, Ohio. $1,326,000. Head closures for 2.75" rocket motors. Elyria. Navy Ships Parts Control Center, Mechanicsburg, Pa.

29—**Grumman Aircraft Engineering Corp.**, Bethpage, L.I., New York. $3,600,000. Long lead time effort for FY–1966 procurement of A6A Weapon Systems. Bethpage. Naval Air Systems Command.

—**Gould-National Batteries, Inc.**, St. Paul, Minn. $3,326,272. Submarine storage batteries, spare cells, and associated technical manuals. Kankakee, Ill. Naval Ship Systems Command.

—**General Precision, Inc., Aerospace Group, Kearfott Products Div., Little Falls, N.J.** $3,131,200. Airborne navigation computer sets. Clifton, N.J. Naval Air Systems Command.

—**Deco Electronics, Inc.**, Washington, D.C. $3,164,969. Radio transmitting and receiving multicouplets and antennas. McLean, Va. Naval Ship Systems Command.

—**Douglas Aircraft Co., Inc.**, Long Beach, Calif. $2,920,394. Additional funding for countermeasures sets and related equipment. Long Beach. Naval Air Systems Command.

—**ITT Federal Laboratories**, Nutley, N.J. $2,762,000. Navy automatic broadcasting processing and routing switch. Paramus, N.J. Navy Purchasing Office, Washington, D.C.

—**Bendix Corp., Bendix Radio Division**, Baltimore, Md. $2,576,148. Increased funds for airborne radio receiver-transmitter sets. Baltimore. Naval Air System Command.

—**Ling-Temco-Vought, Inc.** Greenville, Tex. $2,141,250. Services and materials for aircraft modifications. Greenville. Naval Air Systems Command.

—**Sperry Gyroscope Co.**, Syosset, L.I., N.Y. $1,776,114. Inertial navigation subsystem of Fleet Ballistic Missile Submarines. Syosset. Naval Ship Systems Command.

—**Litton Systems, Inc.**, Woodland Hills, Calif. $1,500,000. Airborne navigation computer set components. Woodland Hills. Naval Air Systems Command.

—**Douglas Aircraft Co.**, Long Beach, Calif. $1,622,729. Bomb ejector racks and related equipment. Torrance, Calif. Naval Air Systems Command.

—**Beech Aircraft Corp.**, Wichita, Kan. $1,488,500. AQM–37A aerial targets. Wichita. Naval Air Systems Command.

—**IBM Corp., Federal Systems Div.**, Bethesda, Md. $1,371,600. Research & development services to improve operation of Navy Command and Control Systems. Bethesda. Navy Purchasing Office, Washington, D.C.

—**Litton Systems Inc., Data Systems Div.**, Van Nuys, Calif. $1,398,448. Sole source contract for spare parts for use on AN/ASA27 digital computer used on E2A aircraft. Van Nuys. Navy Aviation Supply Office, Philadelphia.

—**Westinghouse Electric**, Pittsburgh, Pa. $1,191,562. Refurbishment of nuclear reactor compartment components for Navy nuclear-powered ships. Pittsburgh. Naval Ship Systems Command.

—**Development Corp. of America**, Hollywood, Fla. $2,200,000. Construction of a bachelor officers quarters and mess at the Naval Air Station, Pensacola, Fla. Southeast Div., Naval Facilities Engineering Command.

30—**Janke & Co. Inc.**, Hackensack, N.J. $1,003,274. Construction of four turbine engine test cells at the Army Aeronautical Depot Maintenance Center, Naval Air Station, Corpus Christi, Tex. Naval Facilities Engineering Command.

—**Hughes Tool Co.**, Culver City, Calif. $1,185,000. Research & development on gun pods. Culver City. Naval Air Systems Command.

—**Firestone Tire & Rubber Co.**, Akron, Ohio. $1,983,300. 15 man inflatable life boats. Magnolia, Ark. Navy Ships Parts Control Center, Mechanicsburg, Pa.

—**Trenton Textile Engineering & Manufacturing Co.**, Trenton, N.J. $1,204,000. Parachute and container assemblies for Mark 24 flares. Trenton. Naval Ammunition Depot, Crane, Ind.

—**Woods Hole Oceanographic Institution**, Woods Hole, Mass. $1,982,594. Oceanographic research. Woods Hole. Office of Naval Research, Washington, D.C.

—**Newport News Shipbuilding & DryDock Co.**, Newport, News, Va. $3,000,000. Overhaul and refueling of the USS JOHN MARSHALL (SSB(N)611). Newport News. Naval Ship Systems Command.

—**Bunker Ramo Corp.**, Canoga Park, Calif. $3,200,000. Additional funding for ECM equipment for the Navy. Silver Spring, Md (75%) and Canoga Park (25%). Naval Air Systems Command.

—**M.I.T.**, Cambridge, Mass. $3,450,845. Computer research. Office of Naval Research, Washington, D.C.

—**Scope, Inc.**, Falls Church, Va. $4,345,902.82. Classified electronics equipment. Falls Church. Naval Ship Systems Command.

—**Stanford University**, Palo Alto, Calif. $4,400,000. Continuation of fundamental nuclear research. This contract, which also covers all operations of Stanford's High Energy Physics Laboratory through 1967, calls for further development of the superconducting linear accelerator and the possible application of its principles to the Mark III billion volt accelerator. Palo Alto. Office of Naval Research, Washington, D.C.

—**Sperry Rand Corp.**, Great Neck, L.I., N.Y. $6,068,271. Increased funds for fabrication and test of prototype models of Phase II Great Neck. Naval Air Systems Command.

—**United Aircraft, Sikorsky Aircraft Div.**, Stratford, Conn. $13,800,000. SH–3D helicopters and related equipment. Stratford. Naval Air Systems Command.

—**United Aircraft, Pratt & Whitney Div.**, East Hartford, Conn. $26,299,093. TF–33–P–7 engines for the Air Force. East Hartford. Naval Air Systems Command.

—**North American Aviation, Inc.**, Columbus, Ohio. $3,925,000. Contract Definition Phase II of the CONDOR Missile system. Columbus. Naval Air Systems Command.

—**Columbus Milpar & Manufacturing Co., Inc.**, Columbus, Ohio. $2,256,060. Arming wire assemblies for bombs. Columbus, Ohio. Navy Ships Parts Control Center, Mechanicsburg, Pa.

AIR FORCE

1—**Lear Siegler, Inc.**, Grand Rapids, Mich. $5,559,119. Production of navigation and bombing computer sets for F–4 aircraft. Grand Rapids. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Collins Radio Co.**, Richardson, Tex. $3,630,000. Engineering, production and installation of high frequency, single-sideband communications facilities. Richard-

son. Space Systems Div. (AFSC), Los Angeles.

2—**General Motors**, Indianapolis, Ind. $1,240,-200. Non-recurring maintenance at Air Force Plant Number 26. Aeronautical Systems Div. (AFSC), Wright-Patterson' AFB, Ohio.

3—**Edgerton, Germeshausen & Grier, Inc.**, Goleta, Calif. $1,188,081. Procurement and installation of an instrumentation system. Goleta. Air Force Special Weapons Center (AFSC), Kirtland AFB, N.M.

—**Maxson Electronics Corp.**, Great River, N.Y. $4,379,911. Production of fuze assemblies for bombs. Macon, Ga. Ogden Air Materiel Area (AFLC), Hill AFB, Utah.

—**Boeing Co.**, Seattle, Wash. $3,431,183. Research, development, test and engineering for modernization of wings I through V of the MINUTEMAN weapon system. Seattle. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**Walter Kidde Constructors, Inc.**, New York City. $50,000,000. Design and construction of an airfield and limited port facilities in South Vietnam. Seventh Air Force.

6—**Burroughs Corp.**, Paoli, Pa. $1,555,682. Preliminary work on an air defense system. Paoli. Electronic Systems Div. (AFSC), L.G. Hanscom Field, Mass.

—**Texas Instruments, Inc.**, Dallas, Tex. $2,-673,580. Electronics equipment for RF–4C aircraft. Dallas. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**General Dynamics Corp.**, San Diego, Calif. $1,225,000. Manufacture, integration and launch of space research rockets. San Diego. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

7—**Bullard Co.**, Bridgeport, Conn., $1,598,900. Production of machine tools. Bridgeport. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**AiResearch Mfg. Co.**, Torrance, Calif. $1,-043,366. Production of computer components for F–4 aircraft. Los Angeles. Oklahoma City Air Materiel Area (AFLC), Tinker AFB, Calif.

8—**Northrop Corp.**, Anaheim, Calif. $1,000,000. Technical services in support of the Tactical Intelligence Processing System. Anaheim. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

9—**R.C.A.**, Moorestown, N.J. $1,115,969. Telemetry data systems. Moorestown. Air Force Eastern Test Range (AFSC), Patrick AFB, Florida.

—**Boeing Co.**, Seattle, Wash. $5,026,600. Engineering development for improved Minuteman missiles. Seattle. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**Sperry Rand Corp.**, Charlottesville, Va. $2,751,775. Production of components for airborne radar (AN/APN–59B) for C–141 aircraft. Charlottesville. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

10—**Sylvania Electric Products, Inc.**, Waltham, Mass. $6,920,400. Production of communications equipment for MINUTEMAN Wing I. Buffalo, N.Y. & Waltham. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**Aerojet-General Corp.**, Sacramento, Calif. $3,700,000. Components for the TITAN III rocket system. Sacramento. Space Systems Div., (AFSC), Los Angeles.

13—**TRW Inc.**, Redondo Beach, Calif. $1,024,-000. Work on space/ground communications. Redondo Beach. Air Force Satellite Control Facility (AFSC), Los Angeles.

14—**Northrop Corp.**, Hawthorne, Calif. $1,195,-079. Spare parts & ground equipment for the F–5 aircraft. Hawthorne. San Antonio Air Materiel Area (AFLC) Kelly AFB, Tex.

—**Teledyne Industries, Inc.**, Pasadena, Calif. $1,142,884. Research & development services in support of a seismic data laboratory. Pasadena. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

15—**Thiokol Chemical Corp.**, Brigham City, Utah. $1,920,240. Thrust vector control system for large solid rocket motors. Brigham City. Air Force Flight Test Center (AFSC), Edwards AFB, Calif.

20—**Martin-Marietta**, Denver, Colo. $7,622,000. TITAN III space booster. Denver. Space Systems Div. (AFSC), Los Angeles.

—**Boeing Co.**, Seattle, Wash. $2,400,000. Modernization of MINUTEMAN missiles. Whiteman AFB, Mo. Ballistic Systems Div. (AFSC), Norton AFB, Calif.

—**Sperry Rand Corp.**, Long Island, N.Y. $5,-950,000. Aircraft navigational systems. Long Island. Oklahoma City Air Materiel Area (AFLC), Tinker AFB, Okla.

—**Federal Electric Corp.**, Richland, Wash. $1,159,298. Generator sets (MB–TEEN). Pasco, Wash. Sacramento Air Materiel Area (AFLC), McClellan AFB, Calif.

—**McDonnell Aircraft Corp.**, St. Louis. $1,040,480. Modification kits, spare parts and related data for F–4 aircraft. St. Louis. Ogden Air Material Area (AFLC) Hill AFB, Utah.

21—**Sierra Research Corp.**, Buffalo, N.Y. $1,-465,742. Modification kits, spare parts & engineering services for C–130 aircraft. Buffalo. Warner Robins Air Materiel Area (AFLC), Robins AFB, Georgia.

—**Thiokol Chemical Corp.**, Brigham City, Utah. $1,210,070. Work on 156-inch solid fuel rocket motor. Brigham City. Air Force Flight Test Center (AFSC) Edwards AFB, Calif.

—**Consolidated Diesel Electric Co.**, Stamford, Conn. $5,614,427. Production of fuel servicing tank trucks (5,000 gallons capacity). Stamford. Warner-Robins Air Materiel Area (AFLC) Robins AFB, Ga.

22—**Westinghouse Electric Corp.**, Baltimore, Md. $10,216,000. Design & production of mobile tactical air control radars. Baltimore. Electronic Systems Div (AFSC), L. G. Hanscom Field, Mass.

—**TRW, Inc.**, Redondo Beach, Calif. $1,600,-000. Work on a space program. Redondo Beach. Space Systems Div (AFSC) Los Angeles.

23—**General Motors**, Indianapolis, Ind. $5,744,-469. T–56 engine component improvement program. Indianapolis. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Aerojet-General Corp.**, Downey, Calif. $3,-808,000. Aircraft ordnance dispensers. Downey Air Proving Grounds Center, Eglin AFB, Florida.

—**Aerospace Corp.**, El Segundo, Calif. $7,-400,904. Scientific, engineering, and technical services for support of space & ballistic program. El Segundo. Space Systems Div. (AFSC), Los Angeles.

—**General Electric**, Cincinnati, Ohio. (1) $22,619,791. Production of J–79–10 engines, and (2) $102,670,253. Production of J–79–15 engines. Cincinnati. Aeronautical Systems Div. (AFSC) Wright-Patterson AFB, Ohio.

—The Military Airlift Command, Scott AFB, Ill. has awarded the following contracts for services during FY 1967:

—**Airlift International, Inc.**, Miami, Fla. $18,723,000.

—**Alaska Airlines, Inc.**, Seattle, Wash. $3,-663,000.

—**Braniff International**, Dallas, Tex. $21,-066,000.

—**Capitol Airways, Inc.**, Nashville, Tenn. $9,707,000.

—**Continental Air Lines, Inc.**, Los Angeles, Calif. $29,150,000.

—**Flying Tiger Line, Inc.**, Burbank, Calif. $44,711,000.

—**Northwest Airlines Inc.** St. Paul, Minn. $30,573,000.

—**Overseas National Airways, Inc.**, Washington, D.C. $1,050,000.

—**Pan American World Airways, Inc.** New York, N.Y. $55,358,000.

—**Saturn Airways, Inc.**, Miami, Fla. $13,-451,000.

—**Seaboard World Airlines, Inc.**, Jamaica, N.Y. $22,560,000.

—**Southern Air Transport, Inc.**, Washington, D.C. $7,238,000.

—**Trans Caribbean Airways, Inc.**, New York, N.Y. $7,342,000.

—**Trans International Airlines, Inc.**, Las Vegas, Nev. $9,364,000.

—**World Airways, Inc.**, Oakland, Calif. $23,384,000.

—**Zantop Air Transport, Inc.**, Inkster, Mich. $18,166,000.

—**Trans World Airlines**, New York City. $24,143,000.

24—**Hamilton Watch Co.**, Lancaster, Pa. $1,-066,000. Timers for cluster bomb adapters. Lancaster. Air Proving Ground Center (AFSC), Eglin AFB, Fla.

—**Collins Pipe Co., Inc.**, and **Marwais Steel Co.**, Richmond, Calif. $1,749,400. Production of metal revetment kits for aircraft. Richmond. 2750th Air Base Wing (AFLC), Wright-Patterson AFB, Ohio.

27—**AVCO Corp.**, Williamsport, La. $1,172,059. Expansion of production capability for components of CH–46A helicopters. Williamsport. Aeronautical Systems Div. (AFSC) Wright-Patterson AFB, Ohio.

—**Honeywell, Inc.**, Hopkins, Minn. $2,766,-825. Production of aircraft ordnance. Hopkins Air Proving Ground Center (AFSC), Eglin AFB, Fla.

—**Curtiss-Wright Corp.**, Wood Ridge, N.J. $1,215,416. Production of crankshafts and components for the R–1820 series of aircraft engines. Wood Ridge. San Antonio Air Materiel Area (AFLC), Kelly AFB, Tex.

—**Fairchild Hiller Corp.**, Farmingdale, N.Y. $1,782,340. Engineering services for the modification of the wiring system on F–105 aircraft. Farmingdale. Sacramento Air Materiel Area (AFLC), McClellan AFB, Calif.

28—**General Motors**, Indianapolis, Ind. $26,-546,200. T–56 aircraft engines and related equipment. Indianapolis. Aeronautical Systems Division (AFSC), Wright-Patterson AFB, Ohio.

—**M.I.T.**, Cambridge, Mass. $19,445,000. Research & development of advanced electronic programs including space communications. Cambridge Electronic Systems Div. (AFSC), L. G. Hanscom Field, Mass.

—**Collins Radio Co.**, Cedar Rapids, Iowa. $2,-616,980. Production of communications equipment. Cedar Rapids. Oklahoma City Air Materiel Area (AFLC), Tinker AFB, Okla.

—**Ryan Aeronautical Co.**, San Diego, Calif. $5,169,225. 190 target drones and related equipment. San Diego. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Cutler-Hammer, Inc.**, Deer Park, L.I., N.Y. $1,063,557. Work on airborne reconnaissance systems. Deer Park. (Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**General Electric**, West Lynn, Mass. $8,-927,803. Development program for T–64–12 engines for helicopters. West Lynn. Aeronautical Systems Div. (AFSC), Wright-Patterson AFB, Ohio.

—**Maxson Electronics Corp.**, Great River, L.I., N.Y. $6,406,785. Fuze assemblies for aircraft bombs. Great River. Ogden Air Materiel Area, Hill AFB, Utah.

29—**Stanley Aviation Corp.**, Denver, Colo. $1,-317,462. Kits to modify Navy and Air Force A–1 aircraft with airscrew extractor escape systems. Denver. Sacramento Air Materiel Area (AFLC), McClellan AFB. Calif.

—**Boeing Co.**, Seattle, Wash. Design and development of external bombs for supersonic aircraft. $2,982,750. Incentive contract for modification of B–52 aircraft flight control systems. Seattle. Air Proving Ground Center, Eglin AFB, Fla.

—**Lockheed Missiles and Space Co.**, Sunnyvale, Calif. $4,656,000. Launch services for the Agena rocket from April 1966 to Sept. 1967. Sunnyvale. Space Systems Div vision (AFSC), Los Angeles.

—**Marquardt Corp.**, Van Nuys, Calif. (1) $1,057,745. Non-hydrogen fueled supersonic combustion RAMJET engine; (2) $1,595,-080. Analytical evaluation of advanced RAMJET propulsion systems. Van Nuys. Systems Engineering Group, Wright-Patterson AFB, Ohio.

—**Parsons Corp.**, Traverse City, Mich. $1,-335,160. Compressor blades and related equipment for supersonic propulsion wind tunnels. Traverse City. Arnold Engineering Development Center, Arnold AFS, Tenn.

—**AVCO Corp.**, Wilmington, Mass. $2,875,500. Design development, fabrication, test and evaluation of the Minuteman Mark 11A re-entry vehicles. Wilmington. Ballistics Systems Division (AFSC), Norton AFB, Calif.

30—**General Electric**, West Lynn, Mass. $2,-354,976. Aircraft engines for the T–38 and F–5 aircraft. West Lynn. Aeronautical Systems Division (AFSC), Wright-Patterson AFB, Ohio.

—**United Aircraft**, East Hartford, Conn. $1,399,985. Spare parts for the J–57 aircraft engine. East Hartford. San Antonio Air Materiel Area (AFLC), Kelly AFB, Tex.

—**Litton Industries, Inc.**, San Carlos, Calif. $1,290,000. Research & development of electronic amplifier type tubes. San Carlos. Systems Engineering Group, Wright-Patterson AFB, Ohio.

—**RCA**, Moorestown, N.J. $4,565,000. Production of ground radar equipment. Moorestown. Air Force Western Test Range, Vandenberg AFB, Calif.

—**Northrop Corp.** Hawthorne, Calif. $24,-535,474. Production of T–38 aircraft. Hawthorne. Aeronautical Systems Division, (AFSC), Wright-Patterson AFB Ohio.

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OFFICIAL BUSINESS

POSTAGE AND FEES PAID

Army, Air Force Test New Surfacing for Temporary Airfields and Heliports

While "instant airstrips" remain in the pipe dream stage, temporary tactical airfields and heliports may soon go on short-order lists of the Army and Air Force. A newly developed neoprene-coated surfacing membrane is expected to turn the trick. The material has been subjected to extensive field trials in the United States by the two Services and is being tested in Vietnam under combat conditions.

The Army Test and Evaluation Command (TECOM) has completed integrated engineering/service tests of the T–17 Airfield Surface Membrane. The tests were conducted at Fort Campbell, Ky., with TECOM's Armor-Engineer Board serving as the executive agency for the overall project. Engineering tests were conducted by the Army General Equipment Test Activity, Fort Lee, Va., another TECOM element, with the support of laboratories and technicians of the Army's Engineer Waterways Experiment Station, Vicksburg, Miss.

Aviation units were provided for the tests by the Army Aviation Test Board, a TECOM command located at Fort Rucker, Ala., and the USAF Tactical Air Command. The latter executed landings and take-offs with C–130 cargo aircraft while the board flew missions involving CV–2 and OV–1 aircraft.

The experimental material is intended for use in constructing stable dustproof and waterproof surfaces for temporary airfields. The accordion-folded panels, packaged in wood crates, are dispensed directly from cargo trucks. Alined and straightened by hand, each of the 78x100-foot panels is anchored to the ground with giant steel "tacks." Joints are constructed by overlapping adjoining edges and securing them in place with tack anchors and liquid adhesive to form waterproof seams. Side edges are fastened in V-trenches dug at the sides and ends of the emplaced surface. The ditches are then backfilled and compacted to form smooth shoulders. Surface repairs are made by positioning a piece of membrane under a damaged area and cementing it in place with adhesive.

A heavier surfacing, called the WX18 membrane, is being tested on the touchdown areas at each end of the Fort Campbell runway to determine if tears resulting from aircraft landings can be eliminated. If the WX18 material proves satisfactory, an airfield constructed with a combination of the two membranes should require virtually no maintenance.

Dollars Saved Thru Reduction In Top Secret Documents

The Defense Department has reduced its Top Secret document inventory by 34 percent, thereby realizing a cost avoidance saving of an estimated $124,000 during the 12-month period beginning April 1966. The reduction also lessened the risk of possible compromise of sensitive information. This achievement was accomplished primarily through destruction (94 percent), but also through downgrading, declassification and transfer to Federal Records Centers.

During the period January 15-March 15, 1966, the Military Departments and other components of DOD participated in the project for reducing inventories of Top Secret documents. This 60-day project was approved by the Deputy Secretary of Defense based upon experience gained by the Office of the Secretary of Defense. In a 30-day test ending in November 1965, OSD achieved a 33 percent reduction of Top Secret holdings, thereby yielding an estimated annual cost avoidance of over $5,000.

Participants reported that this project caused all activities to take a more deliberate interest in keeping Top Secret documents to a minimum consistent with current requirements.

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